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THESIS

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ANALYSIS OF UNIT-LEVEL ATTRITION IN THE UNITED STATES ARMY RESERVE

by

Harold S. Hardrick

September 1988

Thesis Advisor: Harold J. Larson

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This thesis investigates the influence of unit characteristics on unit-level manageable attrition and manageable losses suffered by United States Army Reserve units. The objective is to determine whether there are differences in manageable attrition rates/losses of units with different levels of the unit characteristics, and if so, examine the differences. The sample data consist of 914 randomly selected United States Army Reserve units (TPUs). The data were selected from fiscal year 1987 files of the Recruit Market Network System maintained by Litton Computer Services. Analysis of variance techniques were used to examine the differences. The unit characteristics analyzed were found to cause significant differences in attrition rates/losses.

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Analysis of Unit-level Attrition in the United States Army Reserve

by

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

This thesis investigates the influence of unit characteristics on unit-level manageable attrition and manageable losses suffered by USAR units. The objective is to determine whether there are differences in manageable attrition rates/losses of units with different levels of the unit characteristics, and if so, examine the differences. The sample data consist of 914 randomly selected USAR units (TPUs). The data were selected from FY87 files of the Recruit Market Network System maintained by Litton Computer Services. Analysis of variance techniques were used to examine the differences. The unit characteristics analyzed were found to cause significant differences in attrition rates/losses.

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I. INTRODUCTION

Since the beginning of the All-Volunteer Force in 1973, US Army manpower planners have been concerned with the problem of recruiting and retaining sufficient numbers of qualified enlisted personnel in all Army components--Active Army, Army Reserves, and Army National Guard. Although recruiting quotas have largely been met, attrition rates have increased and stabilized at a level that most manpower planners consider excessive.

Attrition is costly and has many adverse effects. It implies increased costs and policy adjustments throughout the manpower system. Its effects pervade recruiting, training, force readiness, and ultimately, retention policies. Therefore, a great deal of attention and resources has been focussed on managing attrition.

Traditionally, research aimed at attrition management has focussed upon the role of individual background charcateristics and individual capabilities such as age, years of education, and ability test scores. Findings reveal that these individual characteristics are linked with attrition but account only for approximately 10% to 25% of the variance in attrition. The key question is "What is responsible for the other 75% to 90% ?" Senior military officials and scientists have hypothesized that unit conditions, policies, and practices such as leadership, training and experiences, and unit characteristics may be linked to attrition. This study assesses the influence of unit characteristics on attrition and is restricted to United States Army Reserve (USAR) units controlled by the US Army Forces Command (FORSCOM). These unit characteristics are categorized as either unit personnel or unit location characteristics. A list of these characteristics is given in Appendix A. FORSCOM controls all assigned USAR troop units in the Continental United States with a few exceptions.

The USAR is an important entity of the "Total Force." It is a statutory Federal force whose mission is to meet Department of the Army mobilization requirements [Ref. 1: p. 3]. USAR forces provide the additional manpower that is required to increase military forces from peace time manning levels to full wartime strength, as well as furnish prompt replacements for casualties. In the event of mobilization, the USAR forces are the principal means of supplementing Active forces during a military emergency. Because it is essential that individuals comprising these augmentation forces be trained in advance to fill time-critical military needs, attrition in the USAR has created major management and mobilization problems. The USAR annual attrition rate has hovered around 30% since 1981 (see Table 1 and Figure 1 on page 3). Curiously, the table and figure indicate a fairly stable attrition rate, with an increasing Beginning Enlisted Strength and an increasing number of Losses. Although stable, these high rates adversely affect the USAR forces' ability to be maintained, trained, and ready to meet Department of the Army mobilization requirements.

Table 1. USAR ENLISTED ATTRITION

FY	Beginning Enlisted Strength (000's)	Losses (000's)	Annual Rate (%)
79	150	53	35
80	154	48	31
81	175	52	30
82	184	55	30
83	204	68	33
84	210.6	66.7	31.7
85	213.6	61.7	28.3
86	227	75.9	32.8
87	237.4	78.6	33.1
Source: Headquarters, Forces Command, J1 Retention Division			

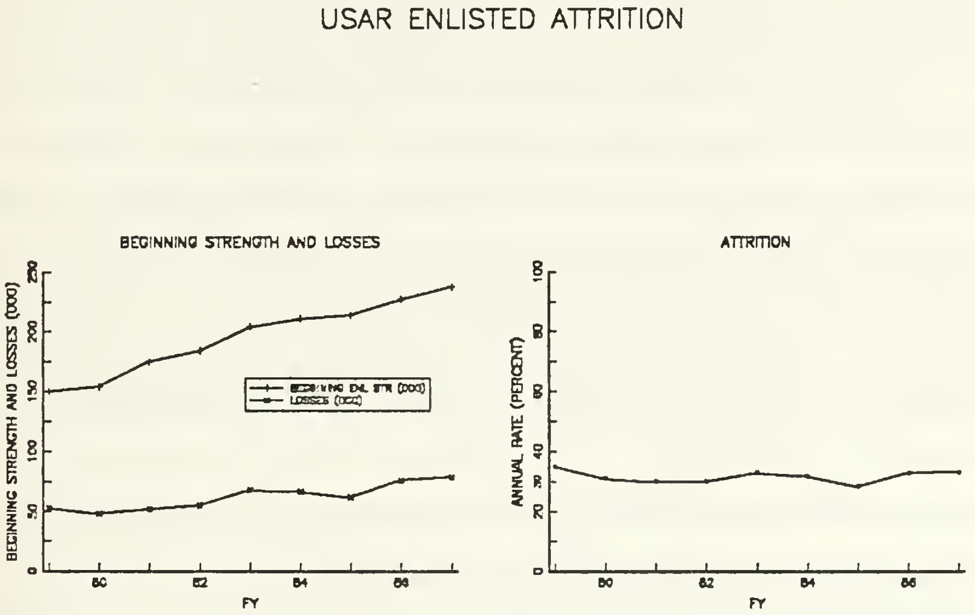

Figure 1. USAR Enlisted Attrition

Reserve forces are organized into three categories: (1) the Ready Reserve, (2) the Standby Reserve, and (3) the Retired Reserve. The Ready Reserve, which is the major source of manpower augmentation for the Active force, consists of the Selected Reserve and the Individual Ready Reserve (IRR). The Selected Reserve consists of Training Program Units (TPU) that are organized for mobilization and deployment. The numbers and types of these units are based upon Department of the Army mobilization requirements. The IRR, on the other hand, consists of individuals intended primarily to augment both Active and Reserve units. The Standby Reserve consists of units and members of the Reserve Components, other than those in the Ready Reserve or Retired Reserve, who are liable for active duty. The Retired Reserve consists of members of the Reserve Components who have attained retirement eligibility. [Ref. 2: p. 1]. Because the Selected Reserve provides the mainstay of mobilization manpower augmentation, it was chosen as the focus for this study.

The Department of the Army defines attrition as all posted loss transactions which reduce strengths. There are three categories of loss transactions.

1. Manageable losses--those losses considered to be under the span of control of the commander.
    - Completion of ready reserve obligation
    - Unsatisfactory participants
    - Voluntary transfers to the Individual Ready Reserve
    - Expiration of term of service
2. Non-manageable losses--those losses not considered to be under the span of control of the commander.
    - Death
    - Transfer to Active component
    - Transfer to Army National Guard
    - Adverse/best interest of the service discharge
    - Revocation of orders

- Miscellaneous

3. Managed transfers--those losses which affect unit strength but do not affect aggregate USAR strength. This category influences soldiers to remain in uniform and is supported by DA.
    - Reassignment of members between commands
    - Reassignment of members within the command

This study focusses on manageable losses/attrition, because it has an adverse effect and is considered controllable. In the past two years, 1986 and 1987, manageable attrition has accounted for over 60% of USAR attrition (see Figure 2 on page 6).

The purpose of this study is to investigate the influence of unit characteristics on enlisted manageable attrition in USAR units controlled by FORSCOM. Section II presents a description of the data base and introduces parameters of the variables used to define attrition, as well as defines the candidate explanatory variables and their associated measures. The unit characteristics are described also in this section. The objective is further defined in Section III, which also discusses the various techniques and procedures employed to accomplish the objective.

Analysis of variance techniques are used to investigate the relative importance of and interrelationship among potential determinants of attrition behavior. The results of the analysis are given in Section IV. Finally, conclusions and recommendations are discussed in Section V.

Given that the Selected Reserve forces provide the primary means of force augmentation and support in the event of mobilization, it follows that prudent management of Reserve force attrition should ultimately enhance the wartime capability of the entire military structure.

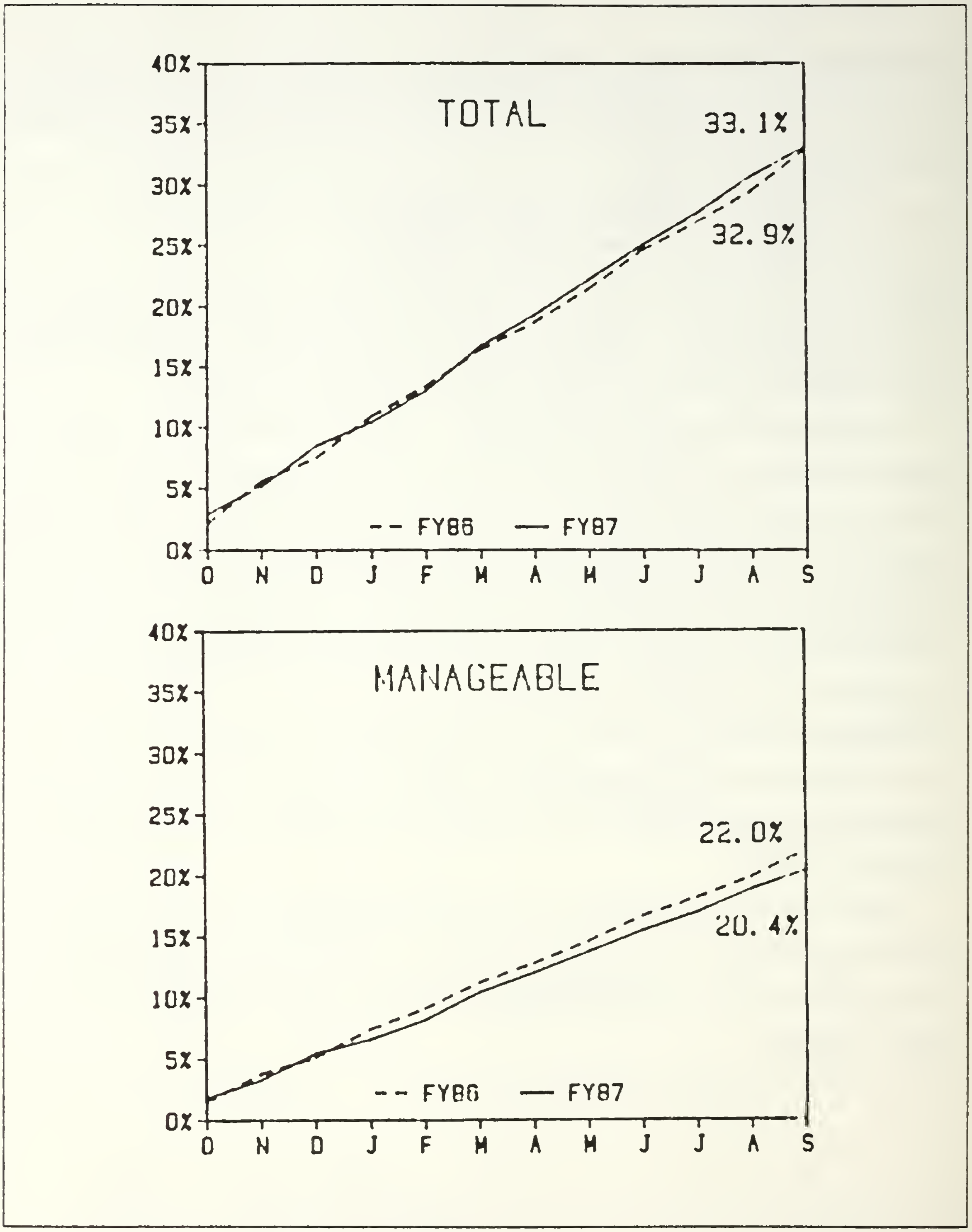

Figure 2. FORSCOM Enlisted Attrition

II. DATA

This section decribes the unit characteristics and data used in the study, and explains how the data file was built. It also presents the results of the exploratory data analysis and general comments about the data.

A. UNIT CHARACTERISTICS

This investigation of USAR enlisted attrition began with the identification of unit characteristics which were thought to influence unit-level manageable attrition. Many unit aspects were considered during this thought process. Some of the key aspects were the unit's leadership, training, location, personnel make-up, and ability to care for its personnel. The question, "What causes USAR attrition?", was presented to many USAR personnel. The answers received and a review of related literature generated the list in Appendix E.

After carefully examining these characteristics and consulting FORSCOM strength analysis personnel, the list was reduced. The characteristics were restricted to those which could be classified as either unit-personnel or unit-location characteristics. The primary reasons for the reduction were (1) to limit the scope of the investigation and (2) the nonavailabilty of data to capture certain characteristics. The reduced list of unit characteristics is given below.

Unit Characteristics

Unit (UIC)
Continental US Army
Major US Army Reserve Command
Type Unit (branch)
Unit Locaton (city, state, zip)
Size of Unit (total enlisted assigned)
Number of Gains (total enlisted gains)
Number of Losses (total enlisted manageable losses)
Attrition Rate (manageable)
Percent Males
Percent Married
Percent Blacks
Percent MOS-match
Percent Non-prior Service
Percent with Bonus
Average Age
Average Education Level
Average Qualification Test Score
Average Time-in-grade (years)
Average Time-in-unit (years)
Average Time til End of Time-in-service (years)
Average Grade
Enlisted-to-officer Ratio
Location Population
Location Income
Location Unemployment Rate
Location Market (available # of potential Reservists)

B. DATA FILE

The data file available consists of 914 randomly selected USAR units, from approximately 4000 USAR units in total. This file contains 70 variables which identify each unit and describe the unit-personnel and unit-location characteristics listed above. Assigned personnel, as well as personnel gains (accessions) and personnel losses, are described by the data. The assigned personnel variables refer to the average number of enlisted personnel assigned throughout FY87. The average number of enlisted personnel assigned is obtained by averaging the year-beginning and year-ending assigned strengths. The gains refer to all accessions who had completed Advanced Individual Training and were acquired during FY87. The losses refer to all manageable losses suffered during FY87. The location variables refer to the population at-large living in a particular zip code area and consist of 1986 figures.

The units are company-sized Selected Reserve units (Troop Program Units,TPUs) controlled by FORSCOM and located within the Continental United States. Of the 914 units, 848 acquired accessions and 855 suffered manageable losses during FY87.

The bulk of the data was acquired from the FORSCOM Strength Analysis Reports (FORSTARS) module and the Demographic Online Retrieval Information System (DORIS) 1986 module. Both modules are components of the Recruit Market Network System and are maintained by Litton Computer Services at Reston, VA [Ref. 3]. The Standard Installation/Division Personnel System (SIDPERS) file, and the 1987 and 1988 Transaction (TRAN) files provided the unit-personnel information. The Unit Identification Code (UIC) file provided the unit identification information. These four files are located within the FORSTARS module. The Zip file, located in the DORIS86 module, provided the unit-location information. The remainder of the data was acquired from the Defense Manpower Data Center (DMDC) at Monterey, CA. This data consisted of unit strength figures.

The data file was built by merging the personnel variables with the location variables, using the unit zip codes. Generating the unit-personnel variables required aggregrating individual information to unit information, since the SIDPERS and TRAN files variable values concern individuals not units. A list and description of the variables in the unit file are given below, beginning on page 11.

For clarification, the Percent MOS-match variables define the percent of enlisted personnel within each unit whose primary or secondary military occupational specialty (MOS) matches their duty specialty. The Percent Non-prior Service--1st Unit variables refer to enlisted personnel assigned or previously assigned to one of the units in the sample, which is or was his (her) initial unit of assignment in the USAR. These persons had no military service prior to this assignment. The Percent Non-prior Service variables refer to enlisted persons who did not have any prior military service before entering the USAR, regardless of whether they entered the USAR one year ago or ten years ago. The Percent Non-prior Service--1st Unit variables are subsets of the Percent Non-prior Service variables. The Average Education Level variables describe the average level of education achieved by the unit's enlisted personnel. The education levels are represented as follows:

1--High School Non-graduate (achieved 11th grade or lower)
2--High School Senior

3--High School Graduate
4--Some College - Baccalaureate Degree
5--Education above Baccalaureate Degree

The Enlisted-officer Ratio variable (EOR) defines the number of enlisted personnel for every officer in the unit. Numerically, EOR is defined by the following equation.

$$EOR = ((BAE + EAE)/2)/((BAO + EAO)/2)$$

where

BAE = Year Beginning Assigned Enlisted Strength
EAE = Year Ending Assigned Enlisted Strength
BAO = Year Beginning Assigned Officer Strength
EAE = Year Ending Assigned Officer Strength

Data File Variables

Type Characteristic	Variable	Description
Identification	UIC	Unit Identification Code
	CON	Continental US Army
	ARGO	Major US Army Reserve Command
	ST	Unit State
	ZIP	Unit Zip
	BR	Unit Branch
Personnel	TASG	Total Assigned
	TGNS	Total Gains
	TLSS	Total Losses
	PMAS	Percent Males (assigned)
	PMGN	Percent Males (gains)
	PMLS	Percent Males (losses)
	PMRA	Percent Married (assigned)
	PMRG	Percent Married (gains)
	PMRL	Percent Married (losses)
	PBKA	Percent Black (assigned)
	PBKG	Percent Black (gains)
	PBKL	Percent Black (losses)
	PMSA	Percent MOS-match (assigned)
	PMSG	Percent MOS-match (gains)
	PMSL	Percent MOS-match (losses)
	PNPA	Percent Non-prior Service (assigned)
	PNPG	Percent Non-prior Service (gains)
	PNPL	Percent Non-prior Service (losses)
	PNFA	Percent Non-prior Service - 1st unit (assigned)
	PNFG	Percent Non-prior Service - 1st unit (gains)
	PNFL	Percent Non-prior Service - 1st unit (losses)
	PBOA	Percent w/ Bonus (assigned)
	PBOG	Percent w/ Bonus (gains)
	PBOL	Percent w/ Bonus (losses)
	AAGE	Average Age (assigned)
	GAGE	Average Age (gains)
	LAGE	Average Age (losses)
	AEDC	Average Education Level (assigned)
	GEDC	Average Education Level (gains)
	LEDC	Average Education Level (losses)
	AAFQ	Average Qualification Test Score (assigned)
	GAFQ	Average Qualification Test Score (gains)
	LAFQ	Average Qualification Test Score (losses)

Data File Variables (cont'd)

Type Characteristic	Variable	Description
	ATIG	Average Time-in-grade (assigned)
	GTIG	Average Time-in-grade (gains)
	LTIG	Average Time-in-grade (losses)
	AETS	Average Time til End of Time-in-service (assigned)
	GETS	Average Time til End of Time-in-service (gains)
	LETS	Average Time til End of Time-in-service (losses)
	AAGR	Average Grade (assigned)
	GAGR	Average Grade (gains)
	LAGR	Average Grade (losses)
	ATUN	Average Time-in-unit (assigned)
	LTUN	Average Time-in-unit (losses)
	BAO	Officer Assigned (beginning of FY87)
	EAO	Officer Assigned (end of FY87)
	BAE	Enlisted Assigned (beginning of FY87)
	EAE	Enlisted Assigned (end of FY87)
	OER	Enlisted-officer Ratio
	ATRN	Attrition
Location	TP86	Total Population (1986)
	A1721	Population - ages 17-21
	A2229	Population - ages 22-29
	A1729	Population - ages 17-29
	MA17	Males - age 17
	MA18	Males - age 18
	M1920	Males - ages 19-20
	MA21	Males - age 21
	M2224	Males - ages 22-24
	M2529	Males - ages 25-29
	M1729	Males - ages 17-29
	PCI86	Per Capita Income (1986)
	AFI86	Average Family Income (1986)
	PUNEM	Percent of Population Unemployed

Note:
1. All personnel variables refer to enlisted personnel except where noted.
2. All personnel variables, designated assigned, refer to the average number of enlisted personnel assigned throughout FY87.
3. All personnel variables, designated gains, refer to all gains during FY87.
4. All personnel variables concerning losses refer to manageable losses throughout FY87.
5. All location variables refer to the population at-large living in a particular zip code area.

C. EXPLORATORY DATA ANALYSIS

Exploratory data analysis (EDA) techniques are used to conduct a preliminary investigation of the data. These techniques are capable of depicting associations between variables of interest, classical properties of the data, and probably most importantly, any possible errors in the data. The EDA techniques can be thought of as "informal" techniques to examine the data prior to "formal", more classical analysis techniques, in order to prevent needless calculations irrelevant to the investigation at hand [Ref. 4: p. 85].

EDA for the purposes of this investigation is defined as "the activity of examining data, both graphically and through numerical summaries." The EDA techniques used are the quantile plot, the boxplot, the scatter plot, and the basic table. The quantile plot and box plot are used to graphically display the data itself. The quantile plot is a display of all the data and the box plot is a summary of the data. A more detailed explanation of these plots are given in Appendix C. The scatter plot is used to graphically display the relationship between the explanatory variables and response variables. The table is used to present the numerical summaries.

The EDA techniques are presented for two variables in the data file. The response variables--attrition and total losses--are presented. All variables in the data file were analyzed similarly. A numerical summary for all variables is given in Appendix F.

1. Attrition

For the purposes of this study, attrition is defined as all posted manageable loss transactions which reduce strengths. Manageable losses are losses considered to be under the span of control of the commander. Numerically, unit-level attrition for a given year is defined by the following equation.

$$\text{Attrition} = \text{Total Losses} / (\text{Beginning Assigned Enlisted} + \text{Total Gains})$$

where

Total Losses = manageable losses suffered during the year
Beginning Assigned Enlisted = enlisted strength at beginning of fiscal year
Total Gains = accessions acquired during fiscal year

The attrition plots in Figure 3 on page 15 show the following aspects of the attrition values.

- The mean and median are colocated and are slightly greater than 0.2.

- The values range from 0.0 to 1.0.
- A large fraction, approximately 90%, of the attrition values are located between 0.1 and 0.35.
- The three largest values are detached from the other values and appear unusually large.
- The distribution of the values is not symmetric.

The three largest values drew special attention and were further investigated. The results of the investigation yielded that these values were valid and originated from units with very small (less than 10) Beginning Assigned Enlisted values. This was the case for most extreme attrition values.

The lack of symmetry appears to be due to the extreme values at both ends of the scale. Symmetry is important because many statistical procedures are designed for, and work best on, symmetric data [Ref. 5: p. 18]. One might want to transform asymmetric data before continuing a study of the data, especially if further studies involve techniques which assume normally distributed data.

2. Total Losses

The total losses variable is defined as the sum of each unit's manageable losses. The total losses plots in Figure 4 on page 16" show the following:

- the mean is larger than the median--mean is 25 and median is 20
- the values range from 0 to 241
- the two largest values are detached from the others and appear unusually large
- 90% of the data are below 65
- an asymmetric distribution

The two largest values were investigated and validated.

3. Other Variables

The preliminary investigation of the other variables revealed that many of the variables were asymmetric and displayed little or no relationship to the attrition rates or number of losses. The spread of some variables was extremely large and yielded large variances. The large spread was expected because of the various sizes of the units within the sample. Many unusual values--extremely large or small values--were identified. Most of these values were validated. The ones that could not be validated were determined to be possible values, and therefore, were not discarded.

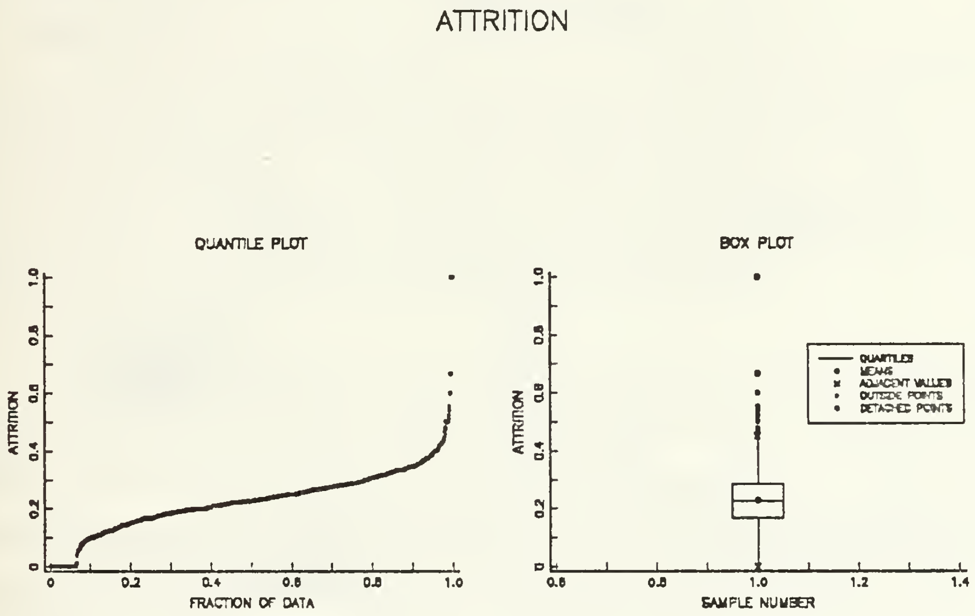

Figure 3. Attrition

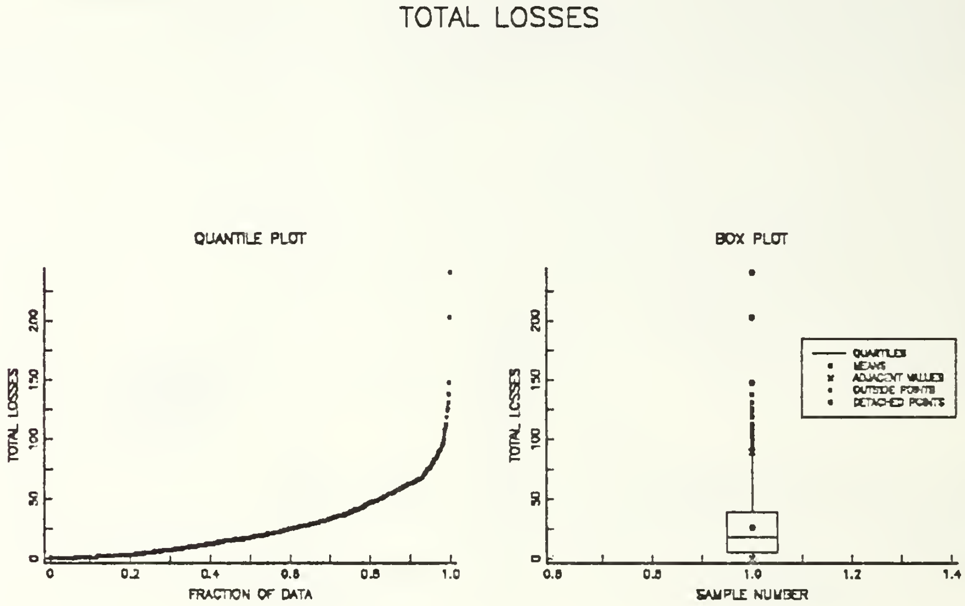

Figure 4. Total Losses

III. METHODOLOGY

This section describes the objective of the study and the methodologies used to accomplish the objective. The methodologies are briefly explained. More detailed explanations are given in Appendices, as noted.

A. OBJECTIVE

The objective of the investigation is to determine whether there are differences in the manageable attrition rates/losses of units with different levels of unit characteristics, and if so, examine the differences. Manageable attrition rates and losses refer to those losses under the span of control of the commander. Accomplishing this objective entails answering several specific questions about the unit characteristics.

1. Types of Units

Do different type units have different attrition rates/losses? Each unit's branch is used to define the type of unit. Each unit within the sample is classified as a school or combat, combat support, combat service support, or training unit. Some key branch-to-branch comparisons within each category are also investigated. The results of the comparisons will reveal whether the two branches have significantly different attrition rates/losses. The branch classifications and key comparisons are given in Table 2 on page 18. The branch comparisons were arbitrarily chosen.

2. Unit Sizes

Do different size units have different attrition rates/losses? Each unit is classified as a large, average, or small unit based upon the average number of enlisted personnel assigned to that unit during FY87 (see Table 3 on page 19).

3. Assigned Personnel Biodemographics

Do units with different personnel biodemographics have different attrition rates/losses? The biodemographics investigated are located in Table 4 on page 19. Each unit is classified as either high, average, or low in reference to each biodemographic.

4. Biodemographics of Accessions

Do units with different types of accessions have different attrition rates/losses? The biodemographics of the gains (newly assigned enlisted personnel acquired during FY87) to each unit are classified as either high, average, or low (see Table 5 on page 20).

5. Location Characteristics

Do units located in different areas have different attrition rates losses? Several aspects associated with unit location are investigated--the Continental United States Armies (CONUSA--1,2,4,5,6), several key state-to-state comparisons, population, unemployment, income, and market available (population between the ages of 17 and 29). The results of the state-to-state comparisons will reveal whether the two states have significantly different attrition rates losses. The comparisons were arbitrarily chosen. Table 6 on page 21 and Table 7 on page 22 give the category values.

Table 2. BRANCH CLASSIFICATIONS

Combat		Combat Support		Combat Service Support		Training		School	
BRCH	N	BRCH	N	BRCH	N	BRCH	N	BRCH	N
AR	9	AV	4	AG c	82	TNG	112	SH	33
FA a	29	CM	33	CA	18				
IN a	20	EN b	97	DC	4				
SF	39	MI	35	FI	5				
		MP b	35	JA d	39				
		SC	4	MC	130				
				OR d	49				
				QM c	75				
				TC	62				
97		208		464		112		33	

Total number of units (TPUs) in sample = 914
Matching small letters indicate branch-to-branch comparisons
N - number of units in sample
Branch (BRCH) descriptions are given in Appendix B.

Table 3. SIZE CLASSIFICATIONS

Small		Average		Large	
Asgn (≤)	N	Asgn	N	Asgn (≥)	N
40	320	41-109	323	110	271

Total number of units (TPUs) in sample = 914
Asgn - number assigned; N - number of units in sample

Table 4. PERSONNEL BIODEMOGRAPHICS -- ASSIGNED

DEMOGRAPHIC	LOW		AVERAGE		HIGH	
	Range (≤)	N	Range	N	Range (≥)	N
Age	27	322	28-29	273	30	319
AFQT	57	312	58-65	319	66	283
Education	2.8	325	2.9-3.0	263	3.1	326
Enlisted-officer Ratio	4	339	5-17	301	18	274
ETS	3.3	323	3.4-3.7	270	3.8	321
Grade	3.9	298	4.0-4.7	330	4.8	286
Time-in-grade	2.0	277	2.1-2.8	330	2.9	307
Time-in-unit	2.0	319	2.1-2.5	303	2.6	292
% Black	9	330	10-34	295	35	289
% w/ Bonus	25	312	26-40	310	41	292
% Males	74	289	75-89	330	90	295
% Married	35	308	36-48	314	49	292
% MOS-match	77	308	78-86	315	87	291
% Non-prior Service	29	301	30-45	311	46	302

Total number of units (TPUs) in sample = 914
N - number of units in sample

Table 5. PERSONNEL BIODEMOGRAPHICS -- ACCESSIONS

DEMOGRAPHIC	LOW		AVERAGE		HIGH	
	Range (≤)	N	Range	N	Range (≥)	N
Age	23	286	24	279	25	283
AFQT	58	281	59-65	283	66	284
Education	2.5	223	2.6-2.7	357	2.8	268
ETS	4.0	262	4.1-5.4	299	5.5	287
Grade	2.6	292	2.7-3.2	269	3.3	287
Time-in-grade	0.9	267	1.0-1.5	312	1.6	269
% Black	6	285	7- 31	269	32	294
% w Bonus	18	273	19-37	285	38	290
% Males	68	288	69-88	281	89	279
% Married	15	283	16-25	292	26	273
% MOS-match	83	273	84-91	288	92	287
% Non-prior Service	27	278	28-49	282	50	288

Total number of units (TPUs) in sample with accessions = 848
N - number of units in sample

Table 6. CONUSA DESIGNATIONS -- STATES

1st Army		2nd Army		4th Army		5th Army		6th Army	
State	N	State	N	State	N	State	N	State	N
CT	12	AL	22	IA e	13	AR	11	AZ	8
DC	0	FL c	34	IL c	41	KS	23	CA a	53
DE	5	GA g	20	IN	24	LA e	15	CO	9
MA	27	KY d	35	MI	26	MO g	20	ID	4
MD	26	MS	16	MN f	20	NE	16	MT	5
ME	4	NC	20	OH c	38	NM	3	ND	4
NH	3	SC	21	WI	27	OK	19	NV	2
NJ	13	TN	15			TX b	54	OR	6
NY a	64							SD	1
PA b	55							UT	9
RI	2							WA d	27
VA f	22							WY	2
VT	3								
WV	16								
251		183		189		161		130	

Total number of units (TPUs) in sample = 914
Matching small letters indicate branch-to-branch comparisons
N - number of units in sample

Table 7. LOCATION CLASSIFICATIONS

ASPECT	LOW		AVERAGE		HIGH	
	Range (≤)	N	Range	N	Range (≥)	N
Population	19960	309	19961-37929	310	37930	295
Total Pop. (17-29) Market Available	4350	299	4351-8599	335	8600	280
Males (17-29) Market Available	2160	324	2161-4099	306	4100	284
Unemployment	4.8	305	4.9-8.3	325	8.4	284
Per Capita Income	9650	297	9651-12299	329	12300	288
Family Income	29914	295	29915-36999	345	37000	274

Total number of units (TPUs) in sample = 914
N - number of units in sample
Range values are 1986 figures

B. ANALYSIS OF VARIANCE

Analysis of variance (ANOVA) techniques are used to accomplish the Objective--determine whether the unit characteristics cause significant differences in unit attrition rates losses. These techniques allow one to simultaneously test whether or not the means of two or more populations are equal [Ref. 6: p. 517]. The unit characteristics which cause significant differences in unit attrition rates losses are identified by the ANOVA techniques.

The underlying assumptions of the basic ANOVA techniques are (1) the populations of interest are normally distributed; (2) the populations have equal standard deviations; and (3) the samples from each population are random and independent--that is, they are not related. If these assumptions cannot be met, another ANOVA technique (Kruskal-Wallis Test), which is based on ranks, may be applied. [Ref. 6: p. 505]. To apply the Kruskal-Wallis Test, the data must be capable of being ranked, and samples must be independent. It is also a distribution-free test, i.e., it can be used regardless of the distribution of the populations. Since the assumption of normality does not appear reasonable for many of the variables, and the Kruskal-Wallis Test is appropriate when populations are not normally distributed, the Kruskal-Wallis Test is used in this study.

A brief discussion of Kruskal-Wallis Test is given in Appendix D. Conover, in Chapter 5, provides an indepth explanation of the Kruskal-Wallis Test [Ref. 7]. A level of significance of 0.05 was used for all tests. The ANOVA, GLM and NPAR1WAY programming statements of the Statistical Analysis System (SAS) software were used to compute the ANOVA. SAS is a software system for data analysis. [Ref. 8].

The unit characteristics were also crossed (with each other) to determine whether their interactions yield significant differences in attrition rates/losses. This analysis is called two-way (three-way) ANOVA. The study of the crossed unit characteristics reveals whether the crossed characteristics should be analyzed jointly or individually.

Analyzing crossed unit characteristics entails considering each category of one characteristic crossed with each category of one or more other characteristics. For example, if Percent Males is crossed with Percent Married, then the analysis would consider units with low percentages of males and low percentages of married; units with low percentages of males and average percentages of marrried; units with low percentages of males and high percentages of married; etc. Nine categories of units would be analyzed to determine whether there are differences in their attrition rates/losses. If the results indicate significant differences, then the interacting characteristics should be considered jointly. In other words, it would be important to understand the nature of attrition rates/losses of each category of Percent Males separately for each category of Percent Married. Otherwise, the results could be misleading. A unit characteristic should be individually analyzed only if there is no evidence that the characteristic interacts with other characteristics [Ref. 9: p.317].

IV. RESULTS OF ANALYSES

This section describes the results of the analyses undertaken to assess the influence of unit characteristics on unit-level manageable attrition in the USAR. **The objective of the study was to determine whether there are differences in manageable attrition rates/losses of units with different levels of the unit characteristics, and if so, examine the differences.** ANOVA techniques were used to accomplish this objective.

The interactions which yield significant differences will be presented first, followed by the Assigned Personnel Biodemographics, the Biodemographics of the Accessions, and the Location Characteristics. The interactions are presented first because the interacting characteristics should not be individually interpreted. The results concerning the interacting characteristics, individually analyzed, are provided for completeness and comparison only.

A. INTERACTIONS BETWEEN UNIT CHARACTERISTICS

The Types of Units, Unit Sizes, Personnel Biodemographics, Biodemographics of Accessions, and Location Characteristics were investigated for significant interactions. These characteristics were crossed with each other to determine whether their interactions yield significant differences in attrition rates losses in all possible ways. For example, the Types of Units were crossed with the Unit Sizes, Biodemographics (assigned and accessions), and Location Characteristics. Each characteristic was analyzed similarly. Over 600 two-way and three-way interactions were investigated.

The results revealed no significant three-way interactions and only three significant two-way interactions. The Types of Units and Unit Sizes are interacting characteristics. The interaction of these characteristics yield significantly different mean attrition rates and mean number of losses. The CONUSA and Per Capita Income characteristics also interact to yield significant differences in both areas. The Age and Education Level interactions, of the personnel assigned and accessions, yield significant differences only in the mean number of losses. All other results indicate insignificant interactions.

1. Types of Units and Unit Sizes

Each unit was classified as a school or combat, combat support, combat service support, or training unit based on its branch designation (see Table 2 on page 18). Each unit was also classified as a small, average, or large unit based on its average number of enlisted personnel assigned during FY87 (see Table 3 on page 19). These characteristics were crossed and their interactions produced significant differences in attrition rates/losses. These results are given in Table 8 on page 26 and Table 9 on page 26 and are shown in Figure 5 on page 27 and Figure 6 on page 28.

a. Attrition

(1) Combat Units. The results indicate that combat units have the same mean attrition rates (MAR) regardless of the size of the unit.

(2) Combat Support (CS) Units. The small CS units have significantly lower MAR than the average and large CS units. The MAR of the average and large CS units are not significantly different. The CS units have the lowest MAR of all units in the small category.

(3) Combat Service Support (CSS) Units. The small CSS units have the lowest MAR, followed in increasing MAR order by the average and large CSS units. The MAR of the average and large CSS units are not significantly different.

(4) Training Units. The large training units have significantly lower MAR than the small and average training units. The MAR of the small and average training units are not significantly different.

(5) Schools. The large schools have the lowest MAR, followed in increasing MAR order by average and small schools. The MAR of all sizes of schools are significantly different. Schools have the lowest MAR of all units in the average and large categories.

b. Losses

The mean number of losses (MNL) are more reflective of the sizes of units rather than the unit types. The small units, all types, have the smallest MNL, followed in increasing MNL order by average and large units. The small combat units have the smallest MNL of all units in the small category. The average and large schools have the smallest MNL of all units in their respective categories. These results are given in Table 9 on page 26.

Table 8. TYPE UNIT AND UNIT SIZE INTERACTION--ATTRITION

TYPE UNIT	UNIT SIZES					
	SMALL		AVERAGE		LARGE	
	N	ATRN	N	ATRN	N	ATRN
C	29	0.28	44	0.28	24	0.28
CS	77	0.18	53	0.28	78	0.28
CSS	162	0.20	154	0.23	148	0.24
TNG	51	0.24	44	0.24	17	0.22
SH	1	0.22	28	0.18	4	0.14

Total number of units (TPUs) in sample = 914
N - number of units in sample
C - combat; CS - combat support; CSS - combat service support
TNG - training; SH - school

Table 9. TYPE UNIT AND UNIT SIZE INTERACTION--LOSSES

TYPE UNIT	UNIT SIZES					
	SMALL		AVERAGE		LARGE	
	N	LOSSES	N	LOSSES	N	LOSSES
C	29	3.62	44	32.45	24	56.75
CS	77	4.54	53	32.51	78	55.26
CSS	162	4.42	154	22.04	148	56.92
TNG	51	4.94	44	15.80	17	31.12
SH	1	7.00	28	13.07	4	19.75

Total number of units (TPUs) in sample = 914
N - number of units in sample
C - combat; CS - combat support; CSS - combat service support
TNG - training; SH - school

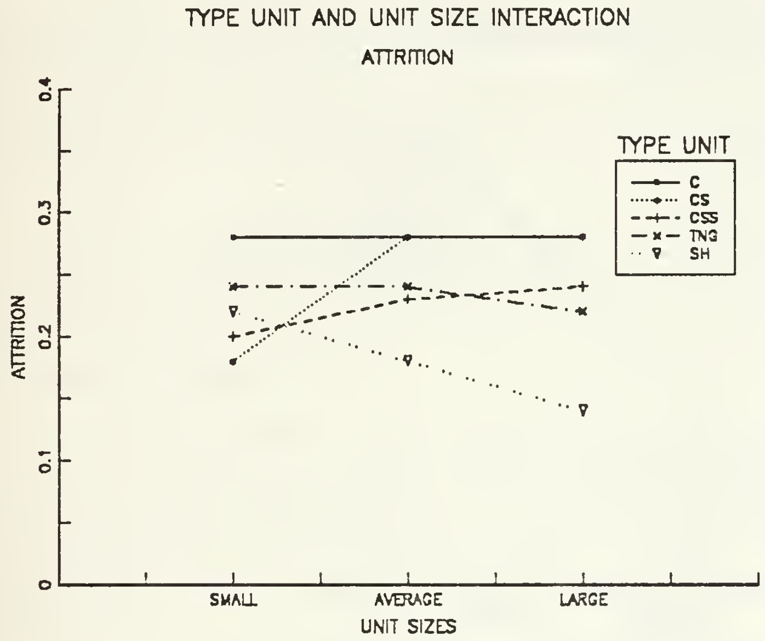

Figure 5. Type Unit and Unit Size Interaction--Attrition

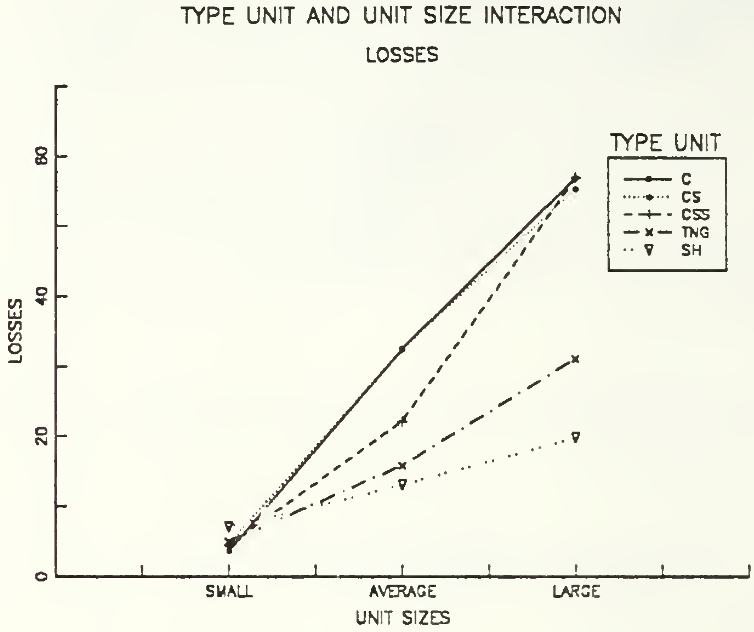

Figure 6. Type Unit and Unit Size Interaction--Losses

2. Per Capita Income (PCI) and CONUSA

Each unit was classified as being located in an area with low, average, or high PCI (see Table 7 on page 22). Each unit was also classified by its CONUSA designation. These characteristics were crossed and their interactions produced significant differences in attrition rates/losses. These results are given in Table 10 on page 30 and Table 11 on page 31 and are shown in Figure 7 on page 32 and Figure 8 on page 33.

a. Attrition

(1) 1st Army. The results indicate that 1st Army units located in low PCI areas have the lowest MAR, followed in increasing MAR order by 1st Army units located in high and average PCI areas. The MAR of 1st Army units located in high and average PCI areas are not significantly different.

(2) 2nd Army. The 2nd Army units located in low PCI areas have significantly lower MAR than 2nd Army units located in average and high PCI areas. The MAR of 2nd Army units located in average and high PCI areas are not significantly different. The 2nd Army units have the lowest MAR of all units located in low PCI areas.

(3) 4th Army. The 4th Army units located in high PCI areas have the lowest MAR, followed in increasing MAR order by 4th Army units located in low and average PCI areas. The MAR of 4th Army units located in high and low PCI areas are not significantly different.

(4) 5th Army. The 5th Army units located in average and high PCI areas have significantly lower MAR than 5th Army units located in low PCI areas. The MAR of 5th Army units located in average and high PCI areas are not significantly different. The 5th Army units have the lowest MAR of all units located in average and high PCI areas.

(5) 6th Army. The 6th Army units located in low and average PCI areas have significantly lower MAR than 6th Army units located in high PCI areas. The MAR of 6th Army units located in low and average PCI areas are not significantly different.

b. Losses

(1) 1st Army. The 1st Army units located low PCI areas have the smallest mean number of losses (MNL), followed in increasing MNL order by 1st Army units located in high and average PCI areas. The MNL of 1st Army units located in low PCI areas are significantly smaller than the MNL of 1st Army units located in high and average PCI areas.

(2) 2nd Army. The MNL of 2nd Army units located in all categories of PCI areas are significantly different. The 2nd Army units located in low PCI areas have the smallest MNL, followed in increasing MNL order by 2nd Army units located in average and high PCI areas.

(3) 4th Army. The 4th Army units located in low and high PCI areas have significantly smaller MNL than 4th Army units located average PCI areas. The MNL of 4th Army units located in the low and high PCI areas are not significantly different. The 4th Army units located in low and high PCI areas have the smallest MNL of all the units located in their respective PCI areas.

(4) 5th Army. The MNL of 5th Army units located in average PCI areas are significantly smaller than the MNL of 5th Army units located in high and low PCI areas. The 5th Army units have the smallest MNL of all units located in average PCI areas.

(5) 6th Army. The MNL of 6th Army units located in all categories of PCI areas are significantly different. The 6th Army units located in average PCI areas have the smallest MNL, followed in increasing MNL order by 6th Army units located in low and high PCI areas.

Table 10. PER CAPITA INCOME AND CONUSA INTERACTION--ATTRITION

CONUSA	PER CAPITA INCOME					
	LOW		AVERAGE		HIGH	
	N	ATRN	N	ATRN	N	ATRN
1	69	0.23	93	0.26	95	0.25
2	72	0.17	72	0.23	33	0.24
4	43	0.22	84	0.24	78	0.21
5	68	0.23	53	0.21	33	0.21
6	45	0.23	27	0.23	49	0.25

Total number of units (TPUs) in sample = 914
N - number of units in sample
C - combat; CS - combat support; CSS - combat service support
TNG - training; SH - school

Table 11. PER CAPITA INCOME AND CONUSA INTERACTION--LOSSES

CONUSA	PER CAPITA INCOME					
	LOW		AVERAGE		HIGH	
	N	LOSSES	N	LOSSES	N	LOSSES
1	69	28.84	93	34.92	95	33.45
2	72	19.17	72	25.12	33	34.36
4	43	16.93	84	27.92	78	18.35
5	68	23.78	53	16.49	33	21.88
6	45	27.09	27	21.70	49	30.20

Total number of units (TPUs) in sample = 914
N - number of units in sample

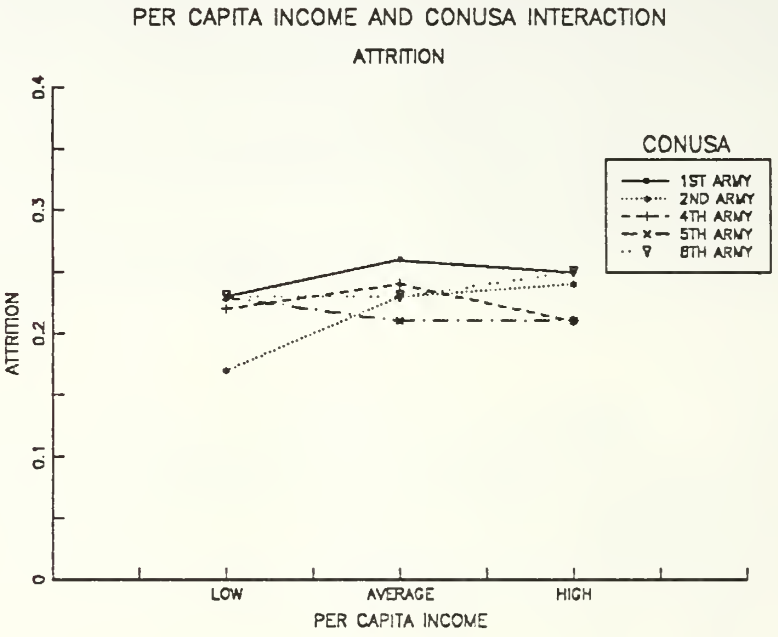

Figure 7. Per Capita Income and CONUSA Interaction--Attrition

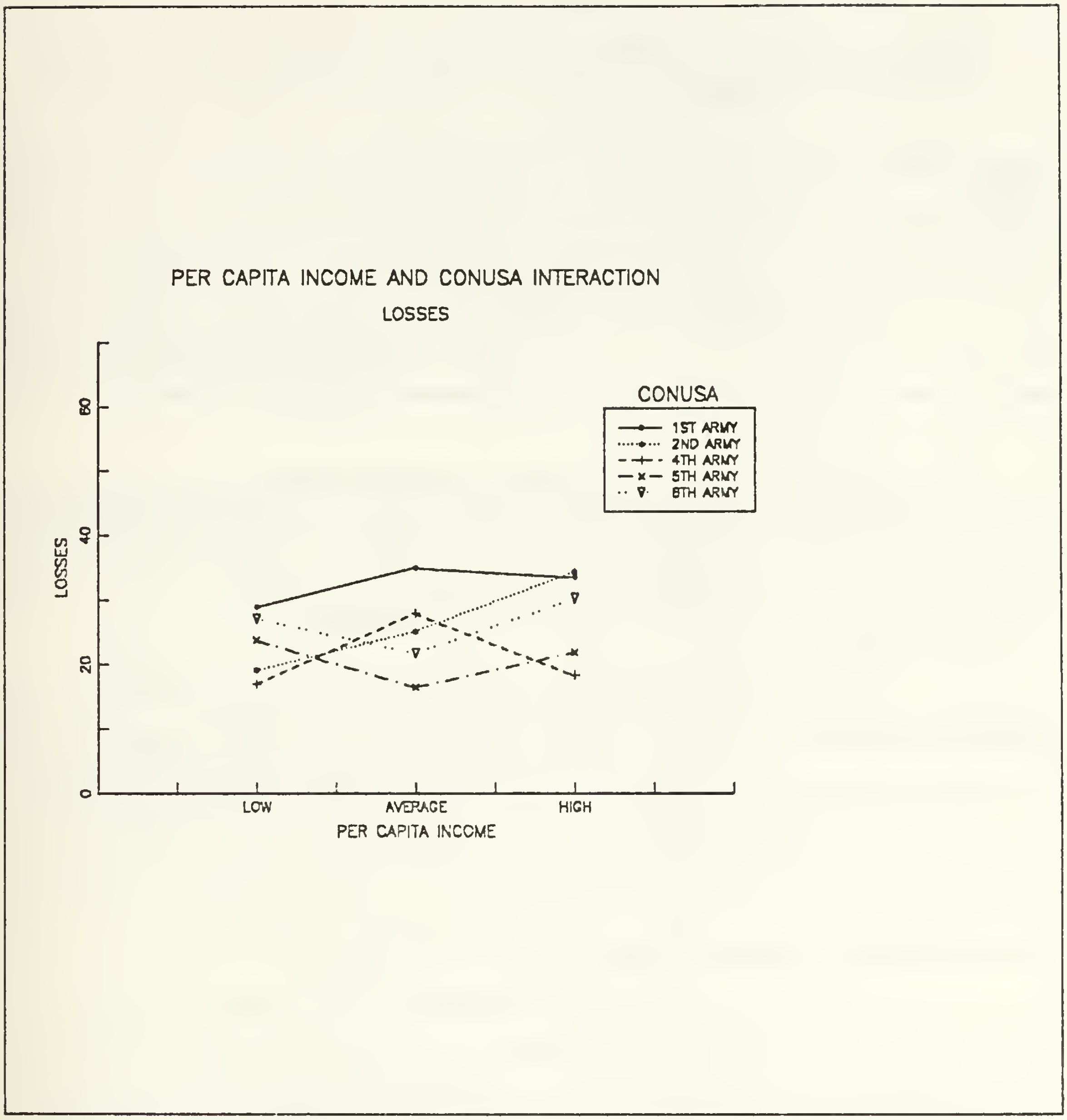

Figure 8. Per Capita Income and CONUSA Interaction--Losses

3. Age and Education

Each unit was classified either low, average, or high according to the average age and average education level achieved by the enlisted personnel (see Table 4 on page 19 and Table 5 on page 20). These characteristics were crossed and their interactions produced significant differences in the mean number of losses suffered by the units. The age crossed with education of assigned personnel, as well as of accessions, produced significantly different MNL. The results are given in Table 12 and Table 13 on page 35 and are shown in Figure 9 on page 36 and Figure 10 on page 37.

a. Assigned Personnel

(1) Low Age. Units with low ages and high education levels have the smallest MNL, followed in increasing MNL order by units with low ages and average education levels, and units with low ages and low education levels. The MNL of units with low ages crossed with each category of education level are significantly different.

(2) Average Age. Units with average ages and high education levels have significantly smaller MNL than units with averages ages and average or low education levels. The MNL of units with average ages crossed with each category of education level are significantly different.

(3) High Age. Units with high ages and high education levels have the smallest MNL, followed in increasing MNL order by units with high ages and low education levels, and units with high ages and average education levels. Units with high ages have the smallest MNL across all categories of education levels.

b. Accessions

(1) Low Age. Units with low ages and high education levels have significantly smaller MNL than units with low ages and low or average education levels. The units with low ages have the smallest MNL of all units with high education levels.

(2) Average Age. Units with average ages and high education levels have the smallest MNL, followed in increasing MNL order by units with average ages and low education levels, and units with average ages and average education levels. The MNL of the three categories of units are significantly different.

(3) High Age. Units with high ages and high education levels have significantly smaller MNL than units with high ages and low or average education levels. The MNL of the three categories of units are significantly different. Units with high ages have the smallest MNL of all units in the low and average education level categories.

Table 12. AGE AND EDUCATION INTERACTION--ASSIGNED/LOSSES

AGE	EDUCATION					
	LOW		AVERAGE		HIGH	
	N	LOSSES	N	LOSSES	N	LOSSES
Low	161	42.12	70	31.67	28	15.71
Average	118	36.97	115	31.81	64	21.41
High	46	14.87	78	17.28	234	12.31
Total number of units (TPUs) in sample = 914 N - number of units in sample						

Table 13. AGE AND EDUCATION INTERACTION--ACCESSION/LOSSES

AGE	EDUCATION					
	LOW		AVERAGE		HIGH	
	N	LOSSES	N	LOSSES	N	LOSSES
Low	106	29.57	141	32.19	39	10.59
Average	75	36.71	147	45.91	57	22.88
High	42	17.29	69	25.75	172	13.30
Total number of units (TPUs) in sample = 914 N - number of units in sample						

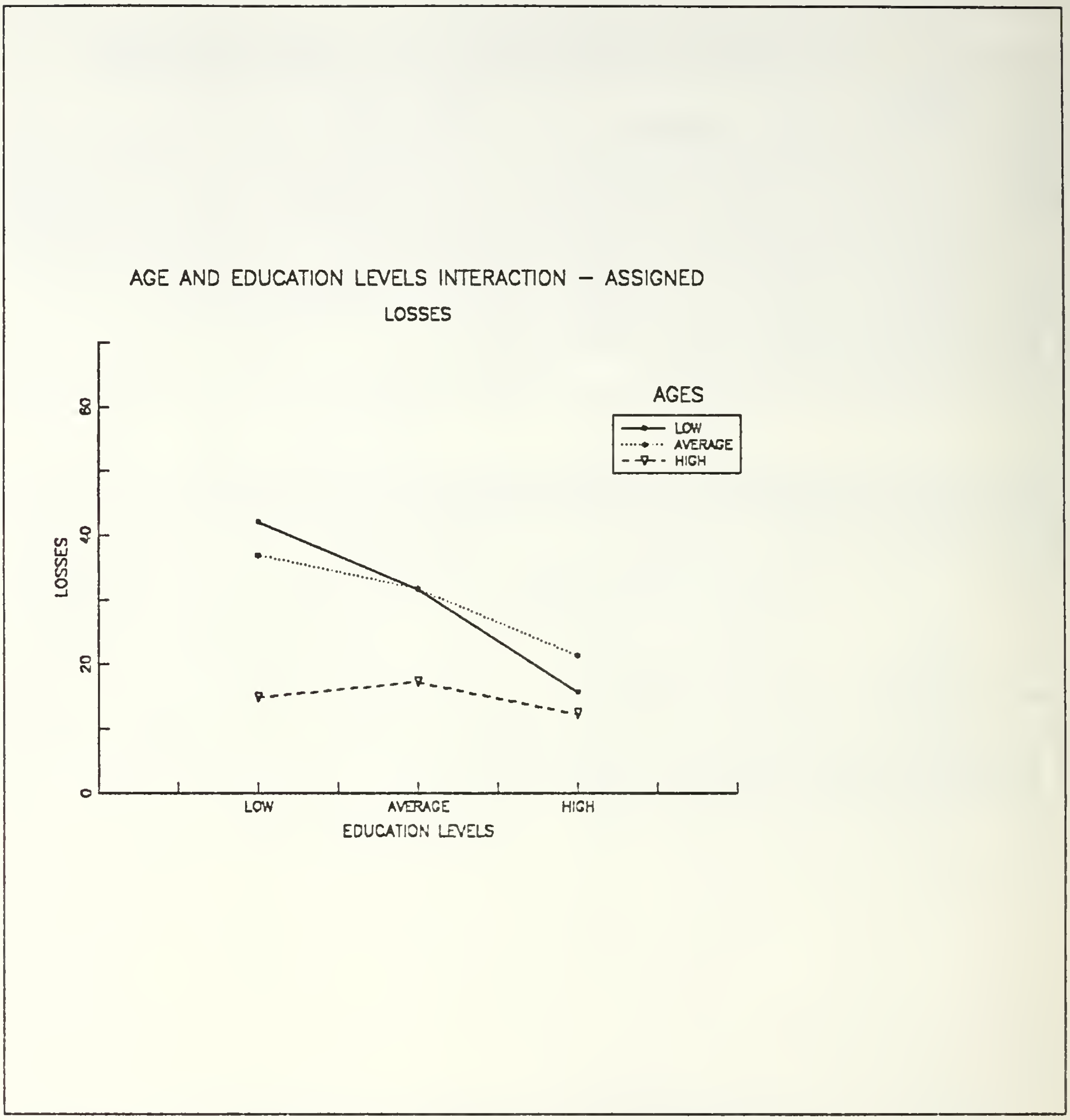

Figure 9. Age and Education Level Interaction--Assigned/Losses

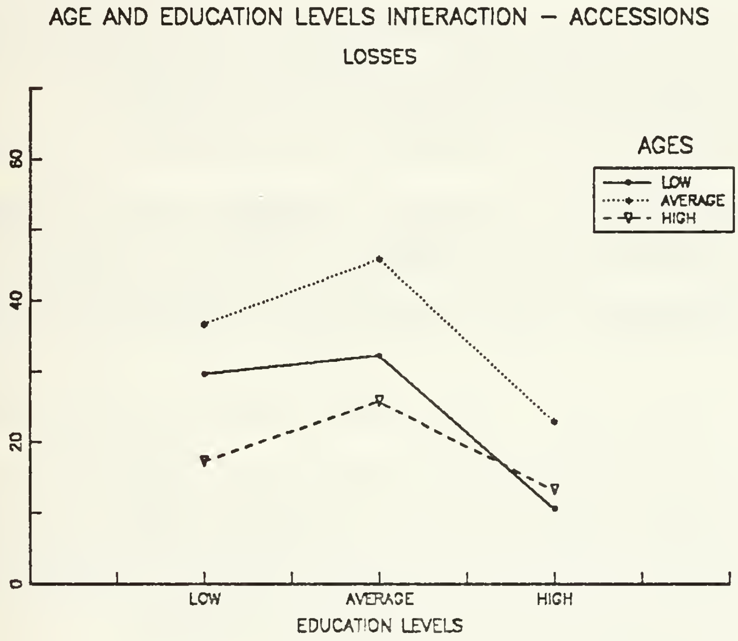

Figure 10. Age and Education Level Interaction--Accessions/Losses

B. INDIVIDUALLY ANALYZED CHARACTERISTICS

The individually analyzed characteristics consist of the Assigned Personnel Biodemographics, the Biodemographics of the Accessions, and the Location Characteristics. The Types of Units, Unit Sizes, CONUSAs, Per Capita Income, Age, and Education Levels are included for completeness and comparison with the interactive results.

1. Assigned Personnel Biodemographics

Do units with different personnel biodemographics have different attrition rates/losses? Each unit was classified as either high, average, or low in reference to each biodemographic based on its assigned enlisted personnel (see Table 4 on page 19). The results indicate that units with different personnel biodemographics have different mean attrition rates (MAR) and different mean number of losses (MNL). All biodemographics, except the percentage of Blacks, are significant in reference to the MAR. The percentage of males is the only biodemographic not significant in reference to the MNL. The results are shown in Table 14 on page 42 and Table 15 on page 43.

a. *Age*

The average age of the unit personnel is a significant biodemographic in reference to attrition rates. The MAR of units with high ages are significantly lower than the rates of units with average and low ages. The units with average and low ages are not significantly different.

Age interacts with Education Levels to yield significantly different MNL. Therefore, the following results concerning MNL should only be compared with the results discussed with the interaction. The MNL for each category of ages is significantly different from the other categories. Units with high average ages have the smallest MNL followed in increasing order by units with average and low average ages.

b. *Armed Forces Qualification Test (AFQT)*

The average AFQT score of the unit personnel is a significant biodemographic in reference to attrition rates and losses. The MAR of units with high average scores are significantly lower than the rates of units with average and low average scores. The units with average and low scores are not significantly different. The same results are indicated for the MNL.

c. *Education Level*

The average education level of the unit personnel is a significant biodemographic in reference to attrition rates. The MAR for all categories of education are significantly different. Units with high average education levels have the lowest MAR, followed in increasing order by units with average and low average education levels.

Education Levels interact with Ages to yield significantly different MNL. Therefore, the following results concerning MNL should only be compared with the results discussed with the interaction. The MNL for all categories of education are significantly different. Units with high education levels have the smallest MNL, followed in increasing order by units with average and low education levels.

d. *Enlisted-officer Ratio (EOR)*

The unit EOR is a significant biodemographic in both areas. The MAR for all categories of unit EOR are significantly different. Units with low EORs have the lowest MAR, followed in increasing order by units with average and high unit EORs. The same results are indicated for the MNL.

e. *Time til End of Time-in-service (ETS)*

The average ETS is a significant biodemographic in both areas. Units with low ETSs have the lowest MAR, followed in increasing order by units with high and average ETSs. The average ETSs of the low and high categories of units are not signficantly different. The ETSs of the high and average units also are not significantly different. The MNL for all categories of ETS is significantly different. Units with low ETSs have the smallest MNL, followed in increasing order by units with average and high ETSs.

f. *Grade*

The average grade is a significant biodemographic in reference to mean attrition rates and mean number of losses. Units with high average grades have the lowest MAR, followed in increasing order by units with average and low average grades. The MAR of units with high average grades are significantly lower than the rates of units with average and low average grades. The average grades of the low and average categories of units are not signficantly different. The MNL for all categories of grades are significantly different. Units with high average grades have the smallest MNL, followed in increasing order by units with average and low average grades.

g. *Time-in-grade (TIG)*

The average Time-in-grade biodemographic is also significant in both areas. The MAR of units with high TIGs are significantly lower than the rates of units with average and low TIGs. The TIGs of the low and average categories of units are not signficantly different. The MNL for all categories of TIG are significantly different. Units with high TIGs have the smallest MNL, followed in increasing order by units with low and average TIGs.

h. *Time-in-unit (TIU)*

The average Time-in-unit biodemographic is significant in reference to MAR and MNL. Units with high averages have the smallest MAR, followed in increasing order by units with average and low times-in-unit. The MAR of units with high averages are significantly lower than the rates of units with average and low averages. The MAR of the low and average category of units are not signficantly different. The MNL of units with low and high times-in-unit are significantly smaller than the MNL for units with average times-in-unit. The MNL of units with low and high TIUs are not significantly different.

i. Percent Blacks

The percentage of Blacks is only significant in reference to the mean number of losses. The MNL for all categories of Blacks are significantly different. Units with low percentages of Blacks are followed in increasing order by units with average and high percentages.

j. Percent with Bonus

The percentage of personnel with bonuses is a significant biodemographic in reference to MAR and MNL. Units with low percentages have the lowest MAR, followed in increasing order by units with high and average percentages. The percentages of the low and high categories of units are not signficantly different. The MNL for units with low percentages are significantly smaller than the MNL for units with average and high percentages. The MNL for units with high and average percentages are not significantly different.

k. Percent Males

The percentage of males is only significant in reference to the mean attrition rates. Units with low percentages have the lowest MAR, followed in increasing order by units with high and average percentages. The percentages of the low and high categories of units are not signficantly different. The percentages of the high and average units also are not significantly different.

l. Percent Married

The percentage of married personnel is a significant biodemographic in reference to MAR and MNL. Units with high percentages have the lowest MAR, followed in increasing order by units with average and low percentages. The MAR of units with high percentages are significantly lower than the rates of units with average and low percentages. The percentages of the low and average categories of units are not signficantly different. The MNL for all categories of Married are significantly different. Units with high percentages have the smallest MNL, followed in increasing order by units with average and low percentages.

m. Percent MOS-match

The percentage of personnel whose duty MOS matches their primary or secondary MOS is a significant biodemographic. Units with high percentages have the smallest MAR, followed in increasing order by units with average and low percentages. The MAR of units with high percentages are significantly lower than the rates of units with average and low percentages. The percentages of the low and average categories of units are not signficantly different. The MNL of units with low and high percentages are significantly smaller than the MNL for units with average percentages. The MNL of units with low and high percentages are not significantly different.

n. Percent Non-prior Service (NPS)

The percentage of non-prior service personnel is a significant biodemographic in reference to attrition rates and losses. The MAR of units with low percentages are significantly lower than the rates of units with average and high percentages. The MAR of units with average and high percentages are not significantly different. The same results are indicated for MNL.

Table 14. ASSIGNED PERSONNEL BIODEMOGRAPHICS--ATTRITION

DEMO-GRAPHIC	CATEGORY								
	Low			Average			High		
	N	Mean	Group	N	Mean	Group	N	Mean	Group
Age	322	0.24	B	273	0.24	B	319	0.20	A
AFQT	312	0.24	B	319	0.24	B	283	0.20	A
Education	325	0.25	C	263	0.23	B	326	0.20	A
EOR	339	0.20	A	301	0.23	B	274	0.26	C
ETS	323	0.22	A	270	0.24	B	321	0.23	A B
Grade	298	0.25	B	330	0.23	B	286	0.20	A
Time-in-grade	277	0.25	B	330	0.25	B	307	0.19	A
Time-in-unit	319	0.25	B	303	0.23	B	292	0.20	A
Blacks **	330	0.22	A	295	0.23	A	289	0.23	A
Bonus	312	0.21	A	310	0.24	B	292	0.23	A
Males	289	0.21	A	330	0.24	B	295	0.23	A B
Married	308	0.24	B	314	0.24	B	292	0.20	A
MOS-match	308	0.24	B	315	0.24	B	291	0.21	A
NPS	301	0.20	A	311	0.24	B	302	0.24	B

Compare categories horizontally
Categories with the same group letter are not significantly different
Total number of units (TPUs) in sample = 914
N - number of units in sample
** - characteristic is not significant

Table 15. ASSIGNED PERSONNEL BIODEMOGRAPHICS--LOSSES

DEMOGRAPHIC	CATEGORY								
	Low			Average			High		
	N	Mean	Group	N	Mean	Group	N	Mean	Group
Age *	322	36.47	C	273	29.18	B	319	12.65	A
AFQT	312	33.87	B	319	29.89	B	283	12.85	A
Education *	325	36.39	C	263	27.46	B	326	14.39	A
EOR	339	16.91	A	301	22.87	B	274	40.61	C
ETS	323	18.16	A	270	27.34	B	321	33.70	C
Grade	298	41.65	C	330	24.94	B	286	10.84	A
TIG	277	28.52	B	330	33.88	C	307	15.18	A
TIU	319	23.85	A	303	31.21	B	292	22.86	A
Blacks	330	20.09	A	295	26.43	B	289	32.24	C
Bonus	312	13.85	A	310	32.43	B	292	32.08	B
Males **	289	23.75	A	330	26.07	A	295	28.04	A
Married	308	35.99	C	314	30.03	B	292	11.05	A
MOS-match	308	21.98	A	315	33.89	B	291	21.64	A
NPS	301	12.74	A	311	30.66	B	302	34.34	B

Compare categories horizontally
Categories with the same group letter are not significantly different
Total number of units (TPUs) in sample = 914
N - number of units in sample
* - interacting biodemographics
** - characteristic is not significant

2. Biodemographics of Accessions

Do units with different types of accessions have different attrition rates/losses? The biodemographics of the gains (newly assigned enlisted personnel) to each unit were classified as either high, average, or low (see Table 5 on page 20). The results indicate that units with different types of accessions have different mean attrition rates and different mean number of losses. All biodemographics of the accessions were found to cause significant differences in MAR and MNL. The results are shown in Table 16 on page 47 and Table 17 on page 48.

a. Age

The MAR for all categories of ages are significantly different. Units with high ages have the lowest MAR, followed in increasing order by units with low and average ages.

Age interacts with Education Levels to yield significantly different MNL. Therefore, the following results concerning MNL should only be compared with the results discussed with the interaction. The MNL for all categories of ages are significantly different. Units with high average ages have the smallest MNL followed in increasing order by units with average and low average ages.

b. Armed Forces Qualification Test (AFQT)

Units with high average AFQTs have the lowest MAR, followed in increasing order by units with average and low AFQTs. The MAR of units with high AFQTs are significantly lower than the rates of units with average and low AFQTs. The MAR of the low and average categories of units are not signficantly different. The same results are indicated for the MNL.

c. Education Level

Units with high levels have the lowest MAR, followed in increasing order by units with average and low levels. The MAR of units with high levels are significantly lower than the rates of units with average and low levels. The levels of the low and average categories of units are not signficantly different.

Education Levels interact with Ages to yield significantly different MNL. Therefore, the following results concerning MNL should only be compared with the results discussed with the interaction. The MNL for all categories of education are significantly different. Units with high education levels have the smallest MNL, followed in increasing order by units with low and education levels.

d. Time til End of Time-in-service (ETS)

Units with high ETSs have the lowest MAR, followed in increasing order by units with low and average ETSs. The ETSs of the low and high categories of units are not signficantly different. The MNL for all categories of ETSs are significantly different. Units with low ETSs have the smallest MNL, followed in increasing order by units with high and average ETSs.

e. Grades

Units with high grades have the lowest MAR, followed in increasing order by units with average and low grades. The MAR for all categories of grades are significantly different. The MNL of units with high grades are significantly smaller than the MNL of units with average and low grades. The MNL of the low and average categories of units are not signficantly different.

f. Time-in-grade (TIG)

Units with low times-in-grade have the lowest MAR, followed in increasing order by units with high and average times-in-grades. The MAR of units with high and low TIGs are significantly lower than the rates of units with average TIGs. The TIGs of the low and high categories are not signficantly different. The MNL for all categories of TIG are significantly different. Units with high TIGs have the smallest MNL, followed in increasing order by units with low and average TIGs.

g. Percent Blacks

Units with low and high percentages of Blacks have significantly lower mean attrition rates than units with average percentages. The MAR of units with low and high percentages are not significantly different. The MNL of units with low percentages are significantly smaller than the MNL of the other categories of units. Units with average and high percentages are not significantly different.

h. Percent with Bonus

Units with high percentages of personnel with bonuses have the lowest MAR, followed in increasing order by units with low and average percentages. The percentages of the high and low categories of units are insignificant. The percentages of the low and average units also are not significantly different. The MNL of units with low percentages are significantly smaller than the MNL of the other categories of units. Units with average and high percentages are not significantly different.

i. Percent Males

The MAR of units with low percentages are significantly lower than the MAR of the other categories of units. Units with average and high percentages are not significantly different. The same results are indicated for the MNL.

j. Percent Married

The MAR for all categories of Married are significantly different. Units with high percentages have the lowest MAR, followed in increasing order by units with low and average percentages. The same results are indicated for the MNL.

k. Percent Mos-match

Units with high percentages have the lowest MAR, followed in increasing order by units with low and average percentages. The MAR of units with high and low percentages are significantly lower than the rates of units with average percentages. The percentages of the low and high categories are not signficantly different. The same results are indicated for the MNL.

l. Percent Non-prior Service (NPS)

Units with high percentages have the lowest MAR, followed in increasing order by units with low and average percentages. The MAR of units with high and low percentages are significantly lower than the rates of units with average percentages. The percentages of the low and high categories are not signficantly different. The MNL for all categories of NPS are significantly different. Units with low percentages have the smallest MNL, followed in increasing order by units with high and average percentages.

Table 16. BIODEMOGRAPHICS OF ACCESSIONS--ATTRITION

DEMO-GRAPHIC	CATEGORY								
	Low			Average			High		
	N	Mean	Group	N	Mean	Group	N	Mean	Group
Age	286	0.23	B	279	0.25	C	283	0.21	A
AFQT	281	0.25	B	283	0.24	B	284	0.21	A
Education	223	0.25	B	357	0.24	B	268	0.21	A
ETS	262	0.23	A	299	0.25	B	287	0.22	A
Grade	292	0.25	C	269	0.23	B	287	0.20	A
Time-in-grade	267	0.22	A	312	0.25	B	269	0.23	A
Blacks	285	0.22	A	269	0.25	B	294	0.23	A
Bonus	273	0.23	A B	285	0.24	B	290	0.22	A
Males	288	0.21	A	281	0.24	B	279	0.25	B
Married	283	0.23	B	292	0.25	C	273	0.21	A
MOS-match	273	0.23	A	288	0.25	B	287	0.22	A
NPS	278	0.23	A	282	0.25	B	288	0.22	A

Compare categories horizontally
Categories with the same group letter are not significantly different
Total number of units (TPUs) in sample with accessions = 848
N - number of units in sample

Table 17. BIODEMOGRAPHICS OF ACCESSIONS--LOSSES

DEMO-GRAPHIC	CATEGORY								
	Low			Average			High		
	N	Mean	Group	N	Mean	Group	N	Mean	Group
Age *	286	28.27	B	279	38.73	C	283	16.93	A
AFQT	281	33.12	B	283	33.07	B	284	17.66	A
Education *	223	29.66	B	357	36.60	C	268	14.94	A
ETS	262	18.47	A	299	35.73	C	287	28.44	B
Grade	292	33.54	B	269	35.48	B	287	15.14	A
TIG	267	26.91	B	312	36.31	C	269	19.21	A
Blacks	285	18.15	A	269	34.30	B	294	31.58	B
Bonus	273	17.90	A	285	33.87	B	290	31.52	B
Males	288	22.19	A	281	32.19	B	279	29.56	B
Married	283	25.34	B	292	37.56	C	273	20.30	A
MOS-match	273	24.23	A	288	37.07	B	287	22.27	A
NPS	278	18.56	A	282	36.38	C	288	28.69	B

Compare categories horizontally
Categories with the same group letter are not significantly different
Total number of units (TPUs) in sample with accessions = 848
N - number of units in sample
* - interacting biodemographics

3. Location

Do units located in different areas have different attrition rates losses? Several aspects associated with unit location are investigated--the Continental United States Armies (CONUSA--1,2,4,5,6), several key state-to-state comparisons, population, unemployment, income, and market available (population between the ages of 17 and 29). Table 6 on page 21 and Table 7 on page 22 give the category values. The results indicate that units located in different areas have different mean attrition rates (MAR) and different mean number of losses (MNL). The CONUSAs are the only location aspect significant in reference to both MAR and MNL. The Per Capita Income is significant only in reference to mean attrition rates. The results are shown in Tables 18-21, beginning on page 49. However, the CONUSAs and Per Capita Income interact to yield significantly different mean attrition rates/losses. Therefore, the following results concerning these two characteristics should only be compared with the results discussed with the interaction.

a. CONUSA

The 2nd Army has the lowest mean attrition rates, followed in increasing order by the 5th, 4th, 6th, and 1st Armies. The MAR of the 2nd, 5th, and 4th are not significantly different. The rates of the 5th, 4th, and 6th Armies are not significantly different. The 4th, 6th, and 1st Armies also have insignificant MAR. Remember "not significant" does not mean "equal."

The 5th Army has the smallest mean number of losses, followed in increasing order by the 4th, 2nd, 6th, and 1st Armies. The MNL of the 5th, 4th, and 2nd Armies are significantly smaller than the MNL of the 6th and 1st Armies. The MNL of the 5th, 4th, and 2nd Armies are insignificant and the MNL of the 6th and 1st are insignificant. The MNL of the 4th, 2nd, and 6th also are not significant. The results are shown in Table 18.

The results of the noted state-to-state comparisons indicate that units located in Texas have significantly lower mean attrition rates and mean number of losses than units located in Pennsylvania. All other noted comparisons indicated no significant differences in either the MAR or the MNL. The comparisons were arbitrarily chosen. The MAR and MNL for each state in the sample are given in Appendix G, Tables 35-38.

Table 18. CONUSA MEANS AND GROUPS

CONUSA	N	ATTRITION		LOSSES	
		Mean	Group	Mean	Group
1	257	0.25	C	32.75	C
2	177	0.21	A	24.42	A B
4	205	0.22	A B C	21.97	A B
5	154	0.22	A B	20.86	A
6	121	0.24	B C	27.15	B C

CONUSAs with the same group letter are not significantly different
Total number of units (TPUs) in sample = 914
N - number of units in sample

Table 19. STATE COMPARISONS

STATE	N	ATTRITION		LOSSES	
		Mean	Result	Mean	Result
New York	64	0.24	NSD	32.23	NSD
vs					
California	53	0.23		26.30	
Pennsylvania	55	0.27	SD	36.58	SD
vs					
Texas	54	0.21		21.93	
Florida	34	0.23	NSD	26.53	NSD
vs					
Ohio	38	0.22		21.66	
Kentucky	35	0.21	NSD	18.26	NSD
vs					
Washington	27	0.22		19.41	
Iowa	13	0.25	NSD	27.00	NSD
vs					
Louisiana	15	0.22		31.13	
Virginia	22	0.19	NSD	24.18	NSD
vs					
Minnesota	20	0.19		25.55	
Georgia	20	0.23	NSD	34.70	SD
vs					
Missouri	20	0.22		13.80	

N - number of units in sample
SD - significantly different
NSD - not significantly different

b. Per Capita Income (PCI)

The units located in areas with low PCIs have the lowest MAR, followed in increasing order by units located in areas with average and high PCIs. The MAR of units located in areas with low PCIs are significantly lower than the other categories of units. The MAR of units located in high and average PCI areas are not significantly different.

Table 20. LOCATION CHARACTERISTICS--ATTRITION

ASPECT	CATEGORY								
	Low			Average			High		
	N	Mean	Group	N	Mean	Group	N	Mean	Group
Population *	309	0.23	A	310	0.23	A	295	0.23	A
Population * (17-29)	299	0.23	A	335	0.23	A	280	0.23	A
Males * (17-29)	324	0.23	A	306	0.23	A	284	0.23	A
Unemployment *	305	0.23	A	325	0.23	A	284	0.22	A
Per Capita Income	297	0.21	A	329	0.24	B	288	0.23	B
Family * Income	295	0.22	A	345	0.23	A	274	0.24	A

Compare categories horizontally
Categories with the same group letter are not significantly different
Total number of units (TPUs) in sample = 914
N - number of units in sample
* - Aspect is not significant

Table 21. LOCATION CHARACTERISTICS--LOSSES

ASPECT	CATEGORY								
	Low			Average			High		
	N	Mean	Group	N	Mean	Group	N	Mean	Group
Population *	309	26.22	A	310	26.35	A	295	25.32	A
Population * (17-29)	299	26.15	A	335	27.02	A	280	24.54	A
Males * (17-29)	324	25.76	A	306	26.63	A	284	25.54	A
Unemployment *	305	26.16	A	325	26.79	A	284	24.84	A
Per Capita * Income	297	23.35	A	329	26.94	A	288	27.59	A
Family * Income	295	24.31	A	345	25.70	A	274	28.12	A

Compare categories horizontally
Categories with the same group letter are not significantly different
Total number of units (TPUs) in sample = 914
N - number of units in sample
* - Aspect is not significant

4. Types of Units

The Types of Units interact with Unit Sizes to yield significantly different mean attrition rates and mean numbers of losses. Therefore, the following results should only be compared with the results produced by the interaction.

Do different types of units have different attrition rates/losses? Each unit within the sample was classified as a school or combat, combat support, combat service support, or training unit (see Table 2 on page 18). The results indicate that different types of units have different mean attrition rates (MAR) and different mean number of losses (MNL). The results are given in Table 22 on page 53.

The results indicate that the MAR of schools are significantly lower than the rates of the other types of units. The MAR of the combat, combat support, combat service support, and training units are not significantly different. Not significantly different does not mean that they are equal.

The schools and training units have significantly smaller MNL than the combat, combat support, and combat service support units. The schools and training units do not have significantly different MNL. The results show also that the MNL for combat, combat support, and combat service support units are not significantly different.

The branch-to-branch comparisons indicate that the MAR and MNL for the Infantry and Field Artillery units are not significantly different. Military Police and Engineer units have significantly different MNL, but their MAR are not significantly different. The same results are indicated for the Adjutant General's Corps and Quartermaster units--MNL are different and MAR are not. The Ordnance and Judge Advocate General's Corps (JAG) units are significantly different for both MAR and MNL, with the JAG units having lower MAR and MNL. These results and other comparisons are given in Table 23 on page 54. The comparisons were arbitrarily chosen. The MAR and MNL for each branch in the sample are given in Appendix G, Tables 29 and 30.

Table 22. TYPE UNIT MEANS AND GROUPS

TYPE UNIT	N	ATTRITION		LOSSES	
		Mean	Group	Mean	Group
SH	33	0.17	A	13.70	A
C	97	0.24	B	29.84	B
CS	208	0.24	B	30.69	B
CSS	464	0.22	B	27.02	B
TNG	112	0.24	B	13.18	A

Unit Types with the same group letter are not significantly different
Total number of units (TPUs) in sample = 914
N - number of units in sample
C - combat; CS - combat support; CSS - combat service support
TNG - training; SH - school

Table 23. BRANCH COMPARISONS

BRANCH	N	ATTRITION		LOSSES	
		Mean	Result	Mean	Result
Infantry	20	0.30	NSD	52.70	NSD
vs					
Field Artillery	29	0.27		40.41	
Engineer	97	0.27	NSD	45.47	SD
vs					
Military Police	35	0.26		27.06	
Adjutant Gen.	52	0.22	NSD	20.40	SD
vs					
Quartermaster	75	0.26		29.80	
Ordnance	49	0.26	SD	45.92	SD
vs					
Judge Adv. Gen.	39	0.17		1.41	
Chemical	33	0.21	NSD	15.48	NSD
vs					
Special Forces	39	0.20		13.67	
Military Intell	35	0.18	SD	7.71	SD
vs					
Military Police	35	0.26		27.06	
Medical Corps	130	0.21	SD	27.14	SD
vs					
Engineer	97	0.27		45.47	
Adjutant Gen.	52	0.22	NSD	20.40	SD
vs					
Transportation	62	0.24		29.08	
Engineer	97	0.27	NSD	45.47	SD
vs					
Training	112	0.24		13.18	
School	33	0.17	NSD	13.70	SD
vs					
Judge Adv. Gen.	39	0.17		1.41	

N - number of units in sample
SD - significantly different; NSD - not significantly different

5. Unit Sizes

The Unit Sizes interact with the Types of Units to yield significantly different mean attrition rates and mean numbers of losses. Therefore, the following results should only be compared with the results produced by the interaction.

Do different size units have have different attrition rates/losses? Each unit was classified as a large, average, or small unit based upon the average number of enlisted personnel assigned to that unit during FY87 (see Table 3 on page 19). The results indicate that different size units have significantly different mean attrition rates (MAR) and significantly different mean number of losses (MNL). The results are shown in Table 11.

The small units have significantly lower MAR than the average and large units. The MAR for the average and large units are not significantly different. The MNL for all categories of sizes are significantly different. Small units have the smallest MNL followed in increasing order by average units and large units.

Table 24. SIZE MEANS AND GROUPS

SIZE	N	ATTRITION		LOSSES	
		Mean	Group	Mean	Group
Small	320	0.20	A	5.15	A
Average	323	0.24	B	25.86	B
Large	271	0.25	B	55.84	C
Sizes with the same group letter are not significantly different Total number of units (TPUs) in sample = 914 N - number of units in sample					

C. SUMMARY

Differences in attrition rates/losses are quite prevalent in units with different levels of the unit characteristics. Most of the unit characteristics used in this study appear capable of affecting attrition rates and losses. The type of unit, unit size, assigned personnel biodemographics, biodemographics of the accessions, and unit location are significant and may cause differences in attrition rates and losses.

Significant interactions between several characteristics are revealed. The Types of Units interact with the Unit Sizes; the Per Capita Income interacts with the CONUSAs; and Age interacts with Education (losses only). The analysis of the interactions provided additional information about the involved characteristics, i.e., additional in the sense that the results are not always what one would expect if only the one-way analysis results are available. Therefore, the interacting characteristics should be considered jointly while being studied. Characteristics that are not significant are the percentage of Blacks of assigned personnel (attrition only); percentage of Males of assigned personnel (losses only); Population; Population (17-29); Males (17-29); Unemployment; Family Income; and Per Capita Income (losses only).

The categories of each characteristic which indicate the lowest mean attrition rates and smallest mean number of losses are given in Table 25 on page 57. The table indicates that the extreme categories (high or low) always yield the lower attrition rates and smaller number of losses. The average categories never yield the most favorable results, but in several instances they produce the least favorable results.

A comparison of the favorable categories for the Assigned Biodemographics and the Biodemographics of Accessions reveals three instances where the categories differ. The specific biodemographics are Time-in-grade, Bonus, and NPS. The differences occur in reference to the attrition rates. A close examination of these biodemographics (of accessions) reveals that the attrition rates of the favorable categories are not significantly different from the attrition rates of the categories which would have indicated the same results for the assigned and accessions. For example, the favorable category for Bonus (A) is Low and the favorable category for Bonus (G) is High. Refering back to Table 16 on page 47, the attrition rates of units with High percentages of Bonus (G) are not significantly different from the attrition rates of units with Low percentages of Bonus (G). A favorable category of Low for Bonus (G) would be consistent with the favorable category (Low) for Bonus (A).

Table 25. FAVORABLE CATEGORIES OF CHARACTERISTICS

CHARACTERISTIC	ATTRITION	LOSSES
Type - Size *	Schools-all sizes	all types-small units
Age (A)	High (GT 29)	***
Education (A)	High (GT 3.0)	***
Age-Education (A) *	**	High (GT 29)-High (GT 3.0)
AFQT (A)	High (GT 65)	High (GT 65)
EOR (A)	Low (LT 5)	Low (LT 5)
ETS (A)	Low (LT 3.4)	Low (LT 3.4)
Grade (A)	High (GT 4.7)	High (GT 4.7)
Time-in-grade (A)	High (GT 2.8)	High (GT 2.8)
Time-in-unit (A)	High (GT 2.5)	Low (LT 2.1)
Blacks (A)	**	Low (LT 10)
Bonus (A)	Low (LT 26)	Low (LT 26)
Males (A)	Low (LT 75)	**
Married (A)	High (GT 48)	High (GT 48)
MOS-match (A)	High (GT 86)	High (GT 86)
NPS (A)	Low (LT 30)	Low (LT 30)
Age (G)	High (GT 24)	High (GT 24)
Education (G)	High (GT 2.7)	High (GT 2.7)
AFQT (G)	High (GT 66)	High (GT 66)
ETS (G)	Low (LT 4.1)	Low (LT 4.1)
Grade (G)	High (GT 3.2)	High (GT 3.2)
Time-in-grade (G)	Low (LT 1.0)	High (GT 1.5)
Blacks (G)	Low (LT 7)	Low (LT 7)
Bonus (G)	High (GT 37)	Low (LT 19)
Males (G)	Low (LT 69)	Low (LT 69)
Married (G)	High (GT 25)	High (GT 25)
MOS-match (G)	High (GT 91)	High (GT 91)
NPS (G)	High (GT 49)	Low (LT 49)
CONUSA-Per Capita Income *	2-Low (LT 9651)	5-Average (9651-12299)

A-assigned personnel biodemographic; G-biodemographic of accessions
GT - greater than; LT - less than; (#) - defines the category values
* - interacting characteristics; ** - characteristic is not significant
*** - characteristic interacts with another characteristic

V. V. CONCLUSIONS AND RECOMMENDATIONS

This section presents the conclusions of the investigation and recommendations for further study in the future. **The objective of the study was to determine whether there are differences in manageable attrition rates/losses of units with different levels of the unit characteristics, and if so, examine the differences.**

A. CONCLUSIONS

1. Units with different levels of the unit characteristics have significantly different attrition rates and numbers of losses.

2. Different Types of Units crossed with different Unit Sizes interact and cause significant differences in manageable attrition rates/losses. These interacting characteristics should be analyzed jointly. Each unit should be classified as a small, average, or large school, combat, combat support, combat service support, or training unit. This should be done prior to investigating a unit's attrition rate or number of losses, if the type or size of the unit is to be considered. Otherwise, the results could be misleading.

3. The unit CONUSAs crossed with the Per Capita Income of the unit locations interact and cause significant differences in manageable attrition rates/losses. These characteristics should be analyzed jointly. Each unit should be classified as being located in a CONUSA region (1,2,4,5, or 6) with low, average, or high Per Capita Income.

4. The average Age crossed with the average Education Level of unit enlisted personnel interact and cause significant differences in the mean numbers of losses suffered by units. These characteristics should also be analyzed jointly.

5. Units with different personnel biodemographics have significantly different mean attrition rates and mean numbers of losses. These significant biodemographics are listed below. Different percentages of Blacks do not cause significant differences in mean attrition rates and different percentages of Males do not cause significant differences in mean numbers of losses. The Age and Education Level (losses only) are interacting characteristics and should be considered jointly.

Average Age
Average AFQT
Average Education Level
Average Enlisted-officer Ratio
Average ETS
Average Grade
Average Time-in-unit
Average Time-in-grade
Percent Blacks
Percent with Bonus
Percent Males
Percent Married
Percent MOS-match
Percent Non-prior Service

6. Units with different types of accessions have significantly different mean attrition rates and mean numbers of losses. The significant biodemographics of the accessions are the same as listed above. The percentages of Blacks and Males of the accessions cause significant differences in mean attrition rates and mean numbers of losses.

5. Units with the lowest attrition rates and units with the smallest numbers of losses have characteristics as shown in Table 26 on page 60.

Table 26. FAVORABLE CHARACTERISTICS

CHARACTERISTIC	ATTRITION	LOSSES
Type - Size *	Schools-all sizes	all types-small units
Age (A)	High (GT 29)	***
Education (A)	High (GT 3.0)	***
Age-Education (A) *	**	High (GT 29)- High (GT 3.0)
AFQT (A)	High (GT 65)	High (GT 65)
EOR (A)	Low (LT 5)	Low (LT 5)
ETS (A)	Low (LT 3.4)	Low (LT 3.4)
Grade (A)	High (GT 4.7)	High (GT 4.7)
Time-in-grade (A)	High (GT 2.8)	High (GT 2.8)
Time-in-unit (A)	High (GT 2.5)	Low (LT 2.1)
Blacks (A)	**	Low (LT 10)
Bonus (A)	Low (LT 26)	Low (LT 26)
Males (A)	Low (LT 75)	**
Married (A)	High (GT 48)	High (GT 48)
MOS-match (A)	High (GT 86)	High (GT 86)
NPS (A)	Low (LT 30)	Low (LT 30)
Age (G)	High (GT 24)	High (GT 24)
Education (G)	High (GT 2.7)	High (GT 2.7)
AFQT (G)	High (GT 66)	High (GT 66)
ETS (G)	Low (LT 4.1)	Low (LT 4.1)
Grade (G)	High (GT 3.2)	High (GT 3.2)
Time-in-grade (G)	Low (LT 1.0)	High (GT 1.5)
Blacks (G)	Low (LT 7)	Low (LT 7)
Bonus (G)	High (GT 37)	Low (LT 19)
Males (G)	Low (LT 69)	Low (LT 69)
Married (G)	High (GT 25)	High (GT 25)
MOS-match (G)	High (GT 91)	High (GT 91)
NPS (G)	High (GT 49)	Low (LT 49)
CONUSA-Per Capita Income *	2-Low (LT 9651)	5-Average (9651-12299)

A-assigned personnel biodemographic; G-biodemographic of accessions
GT-greater than; LT-less than; (#) - defines the category values
* - interacting characteristics; ** - characteristic is not significant
*** - characteristic interacts with another characteristic

B. RECOMMENDATIONS

The unit characteristics analyzed in this study should be considered as viable effects which influence attrition and losses. The development of a predictive model for unit attrition and unit losses might provide additional information about the influence of these characteristics on attrition and losses. These models might also have great impact in terms of manpower policies, such as cutting costs and reducing the adverse effects caused by attrition and losses. Knowing the key ingredients of attrition and losses could lead to better management of the Reserve force and ultimately enhance the wartime capability of the entire military structure.

Further research is also needed to investigate the influence of other unit charcteristics on unit-level manageable attrition and manageable losses. Those characteristics listed in Appendix E provide a good starting point. Capturing these chacteristics should be carefully planned to avoid misleading results.

APPENDIX A. UNIT CHARACTERISTICS

Unit (UIC)
Continental US Army
Major US Army Reserve Command
Type Unit (branch)
Unit Locaton (city, state, zip)
Size of Unit (total enlisted assigned)
Number of Gains (total enlisted gains)
Number of Losses (total enlisted manageable losses)
Attrition Rate (manageable)
Percent Males
Percent Married
Percent Blacks
Percent MOS-match
Percent Non-prior Service
Percent with Bonus
Average Age
Average Education Level
Average Qualification Test Score
Average Time-in-grade (years)
Average Time-in-unit (years)
Average Time til End of Time-in-service (years)
Average Grade
Enlisted-to-officer Ratio
Location Population
Location Income
Location Unemployment Rate
Location Market (available # of potential Reservists)

APPENDIX B. BRANCH DESCRIPTIONS

BRANCH	DESCRIPTION
AG	Adjutant General's Corps
AR	Armor
CA	Civil Affairs
CM	Chemical Corps
DC	Dental Corps
EN	Engineer
FA	Field Artillery
FI	Finance
IN	Infantry
JA	Judge Advocate General's Corps
MC	Medical Corps (includes all except dental)
MI	Military Intelligence
MP	Militsry Police
OR	Ordnance
QM	Quartermaster
SC	Signal Corps
SF	Special Forces
SH	USAR Schools
TC	Transportation Corps
TNG	Training Units

APPENDIX C. QUANTILE PLOTS AND BOX PLOTS

A. QUANTILE PLOTS

The quantile plot provides a good preliminary look at a set of data. A quantile of a set of data is a number on the scale of the data that divides the data into two groups. For example, the .85 quantile, Q(.85), divides a set of data so that a fraction, .85, of the observations fall below this number and a fraction, .15 fall above. The plot is constructed by plotting a set of data that has been ordered from smallest to largest, against $P = (i - .5)/n$, for i = 1 to n; where n = the number of data points. The horizontal scale shows the fractions of P_i and goes from 0 to 1. The vertical scale is the scale of the original data.

Many important properties of the distribution of a set of data are conveyed by the quantile plot. For example, the medians, quartiles, and interquartile range (IQR) are quite easy to read from the plot. The median, Q(.50), divides the data into two groups of equal size. The lower quantile, Q(.25), and upper quantile, Q(.75), split off 25 percent and 75 percent of the data, respectively. The distance from the first to the third quartile, Q(.75) - Q(.25), is called the interquartile range and can be used to judge the spread of the bulk of the data. The local density or concentration of the data is also conveyed by the local slope of the quantile plot; the flatter the slope, the greater the density of points.

The quantile plot is a good general purpose display since it is fairly easy to construct and does a good job of portraying many aspects of a set of data. Every point is plotted at a distinct location, even if there are exact duplicates in the data.

B. BOX PLOTS

The box plot is a summary display of the distribution of a set of data. The upper and lower quartiles of the data are portrayed by the top and bottom of the box. The median is portrayed by a horizontal line segment within the box. The mean (average) is portrayed by a point in the box. Lines extend from the ends of the box to adjacent values. The upper adjacent value is defined to be the largest observation that is less than or equal to the upper quartile plus 1.5 times IQR, where IQR = Q(.75) - Q(.25). The lower adjacent value is defined to be the smallest observation that is greater than or equal to the lower quartile minus 1.5 times IQR. If any data point falls outside of the range of the two adjacent values, it is called an outside value and is plotted as an individual point.

The box plot gives a quick impression of certain prominent features of a set of data. The median shows the center, or location. The spread of the bulk of the data (the central 50%) is seen as the length of the box. The lengths of the lines, extending from the box, relative to the box show how stretched the tails of the distribution are. The outside values gives one the opportunity to consider the question of outliers, that is, observations that seem unusually large or small. The box plot also allows a partial assessment of symmetry. If the distribution is symmetric then the box plot is symmetric about the median: the median cuts the box in half, the upper and lower lines are about the same length, and the outside values at the top and bottom, if any, are about equal in number and symmetrically placed.

Box plots are useful in situations where it is either not necessary or not feasible to portray all the details of the distribution. The width of the box has no particular meaning.

APPENDIX D. KRUSKAL-WALLIS TEST (ANOVA)

The Kruskal-Wallis analysis of variance technique uses sample information to determine whether or not two or more treatments (levels of variables) produce different results. A treatment is a cause, or specific source of variation in a set of data. For example, "Are four different training methods (the treaments) equally effective?" One might conclude that the methods are equally effective, meaning that the differences in the sample data are due to chance (sampling).

The Kruskal-Wallis test is a function of the ranks of the observations. All the sample values are combined; the combined values are ordered from low to high; and the ordered values are replaced by ranks starting with 1 for the smallest value. To apply the test, the data must be capable of being ranked, and samples must be independent. No assumptions about the shape of the distributions are required. In other words, the test is distribution-free.

The Kruskal-Wallis procedure for individually analyzed characteristics calls for six steps.

Step 1: State the null hypothesis, H_o, and the alternative hypothesis, H_1.
The null hypothesis states that there is no statistical difference among the means, i.e., $\mu_1 = \mu_2 = \mu_3$. The alternative hypothesis states that at least one mean is different. If the null hypothesis is rejected, the alternative hypothesis will be accepted.

Step 2: Select a level of significance, α --usually 0.05 or 0.01.
The level of signficance is the risk one assumes if the null hypothesis is rejected when it is actually true.

Step 3: Combine and rank the data.
Combine all the values, and rank them starting with the lowest value which is given the rank of 1.

Step 4: Compute the statistical test.
The appropriate test to be applied is the KW-test, and is defined as

$$KW = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1)$$

where i = 1,2,3,...,k
N is the combined number of observations for all treatments

k is the number of treaments
R_i is the sum of the ranks per treatment
n_i is the number of observations per treatment

Step 5: Formulate a decision rule based on the statistical test.

The decision rule is to accept the null hypothesis if the computed KW-value is less than the critical value of the chi-square distribution; reject the null hypothesis and accept the alternative hypothesis if the computed KW-value is greater than the critical value of the chi-square distribution, using a predetermined level of significance.

The critical value is found by entering a chi-square distribution table (at the predetermined level of significance) with the appropriate degrees of freedom (k-1).

Step 6: Arrive at a decision

If the computed KW-value is less than the critical value, the means might be considered the same. In other words, the differences in the means can be attributed to chance (sampling).

APPENDIX E. UNIT CHARACTERISTICS -- INITIAL LIST

Unit (UIC)
Continental US Army
Major US Army Reserve Command
Type Unit (branch)
Unit Locaton (city, state, zip)
Size of Unit (total enlisted assigned)
Number of Gains (total enlisted gains)
Number of Losses (total enlisted manageable losses)
Attrition Rate (manageable)
Percent Males
Percent Married
Percent Blacks
Percent MOS-match
Percent Non-prior Service
Percent with Bonus
Average Age
Average Education Level
Average Qualification Test Score
Average Time-in-grade (years)
Average Time-in-unit (years)
Average Time til End of Time-in-service (years)
Average Grade
Enlisted-to-officer Ratio
Location Population
Location Income
Location Unemployment Rate
Location Market (available # of potential Reservists)
Rank Structure (# assigned by MOS)
Promotion Rate (# eligible vs # promoted)
Number of Enlisted w/ Full-time Civilian Jobs
Retention NCO Available
Average Number of Dependents
Reenlistment Rating (# eligible vs # reenlisted)
Readiness Rating
Availability of Leaders (Cdr, XO, 1SG, Plt Ldrs, PSG)
Leaders Time-in-position (Cdr, XO, 1SG, Plt Ldrs, PSG)
Leader Level of Military Education
Availability of Equipment (%)
Visits to Training Sites
Number of Awards and Incentives
Number of Disciplinary Actions
Number of Pay Problems (extended beyond 4 RSUTAs)
Number of Social Functions and Family Activities
Assimilation of New People (good, fair, poor)
Spouse/Friend Attitude (good, fair, poor)
Civilian Employer Attitudes
Open Door Policy (good, fair, poor)
Quality of Food Service (good, fair, poor)
Average Active Duty Time
Average Travel Distance to Reserve Center
Number and Type of Unit(s) w/n Same Area (zip)

APPENDIX F. NUMERICAL SUMMARY OF DATA FILE VARIABLES

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN
ATRN	914	0.23	0.12	0.00	1.00	0.01
TLSS	914	25.97	27.11	0.00	241.00	0.90
TASG	914	81.06	68.81	1.00	557.00	2.28
TGNS	914	25.89	26.16	0.00	218.00	0.87
PMAS	914	79.95	17.76	0.00	100.00	0.59
PMGN	848	75.79	22.06	0.00	100.00	0.76
PMLS	855	78.74	21.81	0.00	100.00	0.75
PMRA	914	43.47	17.45	0.00	100.00	0.58
PMRG	848	23.57	20.30	0.00	100.00	0.70
PMRL	855	35.61	21.49	0.00	100.00	0.73
PBKA	914	26.21	26.03	0.00	100.00	0.86
PBKG	848	24.85	25.57	0.00	100.00	0.88
PBKL	855	25.42	24.95	0.00	100.00	0.85
PMSA	914	79.14	15.76	0.00	100.00	0.52
PMSG	848	84.55	16.70	0.00	100.00	0.57
PMSL	855	71.41	21.68	0.00	100.00	0.74
PNPA	914	36.33	18.24	0.00	100.00	0.60
PNPG	848	38.10	24.35	0.00	100.00	0.84
PNPL	855	33.06	21.61	0.00	100.00	0.74
PNFA	914	80.33	27.33	0.00	100.00	0.90
PNFG	848	85.28	34.26	0.00	100.00	1.18
PNFL	855	71.48	37.70	0.00	100.00	1.29
PBOA	914	31.79	18.26	0.00	100.00	0.60
PBOG	848	29.61	22.06	0.00	100.00	0.76
PBOL	855	22.61	19.15	0.00	100.00	0.65
AAGE	914	29.68	4.19	18.30	52.70	0.14
GAGE	848	24.49	3.40	17.00	48.70	0.12
LAGE	855	27.26	4.01	18.70	56.20	0.14
AEDC	914	2.99	0.35	2.00	4.50	0.01
GEDC	848	2.71	0.36	1.00	4.30	0.01
LEDC	855	2.67	0.49	1.00	5.00	0.02
AAFQ	914	61.66	10.49	28.00	99.00	0.35
GAFQ	848	63.59	11.14	32.00	99.00	0.39
LAFQ	855	59.01	12.10	22.00	99.00	0.42
ATIG	914	2.63	1.12	0.10	14.00	0.04
GTIG	848	1.43	0.96	0.00	10.80	0.03
LTIG	855	2.75	1.18	0.20	13.60	0.04
AETS	914	3.50	0.66	0.00	6.90	0.02
GETS	848	4.75	1.52	0.10	8.00	0.05
LETS	855	2.99	1.07	0.10	7.80	0.04
AAGR	914	4.46	0.89	2.00	9.00	0.03
GAGR	848	3.06	0.92	1.00	8.00	0.03
LAGR	855	3.84	0.85	1.00	9.00	0.03
ATUN	914	2.34	0.74	0.30	7.20	0.02
LTUN	855	1.65	0.83	0.10	9.10	0.03

NUMERICAL SUMMARY OF DATA FILE VARIABLES (CONT'D)

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	STD ERROR OF MEAN
BAO	914	13.81	24.51	0.00	239.00	0.81
EAO	914	14.14	24.67	0.00	244.00	0.82
BAE	914	77.80	69.37	1.00	544.00	2.29
EAE	914	77.31	67.71	1.00	553.00	2.24
OER	914	13.57	15.84	0.13	129.00	0.52
TP86	914	29610.12	19194.04	104.00	117375.00	634.88
A1721	914	2603.26	1926.11	8.00	11986.00	63.71
A2229	914	4301.05	2879.36	15.00	17737.00	95.24
A1729	914	6904.31	4709.78	24.00	28971.00	15.79
MA17	914	263.25	189.38	1.00	1853.00	6.26
MA18	914	285.53	234.29	1.00	2710.00	7.75
M1920	914	636.47	618.61	2.00	6902.00	20.46
MA21	914	313.07	294.29	0.00	3003.00	9.73
M2224	914	896.22	648.05	2.00	5041.00	21.43
M2529	914	1299.63	852.28	3.00	5852.00	28.19
M1729	914	3694.18	2615.03	9.00	20354.00	86.50
PCI86	914	11032.42	3107.40	1814.00	21941.00	102.78
AFI86	914	33770.07	7711.23	14269.00	56424.00	25.06
PUNEM	914	7.20	4.43	0.24	27.78	0.15

NOTE: 1. 66 units did not have any gains
2. 59 units did not have any losses

APPENDIX G. SUMMARIES OF UNIT TYPES, BRANCHES, UNIT SIZES, CONUSAS, AND STATES

Table 27. NUMERICAL SUMMARY OF UNIT TYPES -- ATTRITION

UNIT TYPE	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
Combat	0.24	0.10	0.00	0.54	0.01
Combat Support	0.24	0.10	0.00	0.55	0.01
Combat Service Support	0.22	0.12	0.00	1.00	0.01
Training	0.24	0.15	0.00	1.00	0.01
School	0.17	0.06	0.08	0.30	0.01

Table 28. NUMERICAL SUMMARY OF UNIT TYPES -- LOSSES

UNIT TYPE	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
Combat	29.84	26.48	0.00	119.00	2.69
Combat Support	30.69	28.24	0.00	148.00	1.96
Combat Service Support	27.02	28.72	0.00	241.00	1.33
Training	13.18	15.07	0.00	94.00	1.42
School	13.70	6.49	4.00	27.00	1.13

Table 29. NUMERICAL SUMMARY OF BRANCHES -- ATTRITION

BRANCH	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
Adjutant Gen. Corps	0.21	0.12	0.00	1.00	0.01
Armor	0.18	0.10	0.00	0.34	0.03
Aviation	0.12	0.10	0.00	0.20	0.05
Civil Affairs	0.21	0.06	0.10	0.34	0.01
Chemical	0.21	0.10	0.00	0.43	0.02
Dental Corps	0.18	0.07	0.10	0.24	0.03
Engineer	0.27	0.08	0.09	0.55	0.01
Field Artillery	0.27	0.08	0.14	0.46	0.01
Finance	0.21	0.09	0.13	0.34	0.04
Infantry	0.30	0.11	0.00	0.54	0.02
Judge Adv. Gen. Corps	0.17	0.16	0.00	0.60	0.02
Medical Corps	0.21	0.12	0.00	0.67	0.01
Military Intell.	0.18	0.13	0.00	0.44	0.02
Military Police	0.26	0.07	0.07	0.42	0.01
Ordnance	0.26	0.07	0.07	0.43	0.01
Quartermaster	0.26	0.08	0.07	0.43	0.01
Signal Corps	0.35	0.10	0.22	0.45	0.05
Special Forces	0.20	0.09	0.00	0.36	0.02
Transportation	0.24	0.13	0.00	1.00	0.02
Training	0.24	0.15	0.00	1.00	0.01
School	0.17	0.06	0.08	0.30	0.01

Table 30. NUMERICAL SUMMARY OF BRANCHES -- LOSSES

BRANCH	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
Adjutant Gen. Corps	26.22	26.49	0.00	96.00	2.92
Armor	15.11	16.40	0.00	47.00	5.46
Aviation	1.25	0.96	0.00	2.00	0.48
Civil Affairs	22.06	11.08	6.00	46.00	2.61
Chemical	15.48	17.42	0.00	61.00	3.03
Dental Corps	5.75	2.06	3.00	8.00	1.03
Engineer	45.47	27.31	1.00	148.00	2.77
Field Artillery	40.41	24.92	14.00	119.00	4.63
Finance	18.80	1.79	16.00	20.00	0.80
Infantry	52.70	27.71	0.00	113.00	6.20
Judge Adv. Gen. Corps	1.41	1.35	0.00	5.00	0.22
Medical Corps	27.14	36.87	0.00	241.00	3.23
Military Intell.	7.71	14.51	0.00	59.00	2.45
Military Police	27.06	22.02	4.00	76.00	3.72
Ordnance	45.92	28.12	2.00	124.00	4.02
Quartermaster	29.80	20.46	2.00	113.00	2.36
Signal Corps	59.75	43.08	11.00	96.00	21.54
Special Forces	13.67	13.91	0.00	61.00	2.23
Transportation	29.08	22.89	0.00	108.00	2.91
Training	13.18	15.07	0.00	94.00	1.42
School	13.70	6.49	4.00	27.00	1.13

Table 31. NUMERICAL SUMMARY OF UNIT SIZES -- ATTRITION

SIZE	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
Small	0.20	0.16	0.00	1.00	0.01
Average	0.24	0.08	0.04	0.55	0.01
Large	0.25	0.07	0.00	1.00	0.01

Table 32. NUMERICAL SUMMARY OF UNIT SIZES -- LOSSES

SIZE	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
Small	4.47	5.56	0.00	59.00	0.31
Average	23.55	15.93	2.00	138.00	0.89
Large	54.26	28.06	6.00	241.00	1.70

Table 33. NUMERICAL SUMMARY OF CONUSAS -- ATTRITION

CONUSA	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
1	0.25	0.12	0.00	1.00	0.01
2	0.21	0.11	0.00	1.00	0.01
4	0.22	0.13	0.00	1.00	0.01
5	0.22	0.09	0.00	0.50	0.01
6	0.24	0.11	0.00	0.52	0.01

Table 34. NUMERICAL SUMMARY OF CONUSAS -- LOSSES

CONUSA	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
1	32.75	32.79	0.00	241.00	2.04
2	24.42	26.00	0.00	148.00	1.95
4	21.97	21.98	0.00	94.00	1.53
5	20.86	20.33	0.00	92.00	1.64
6	27.15	28.16	0.00	126.00	2.56

Table 35. NUMERICAL SUMMARY OF STATES -- ATTRITION

STATE	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
Alabama	0.19	0.08	0.00	0.28	0.02
Arizona	0.26	0.13	0.06	0.50	0.05
Arkansas	0.20	0.10	0.00	0.41	0.03
California	0.23	0.12	0.00	0.52	0.02
Colorado	0.22	0.11	0.00	0.36	0.03
Connecticut	0.25	0.11	0.00	0.39	0.03
Delaware	0.28	0.10	0.11	0.35	0.05
Florida	0.23	0.10	0.00	0.42	0.02
Georgia	0.23	0.11	0.00	0.43	0.02
Idaho	0.24	0.16	0.00	0.35	0.08
Illinois	0.26	0.16	0.00	1.00	0.02
Indiana	0.26	0.09	0.00	0.44	0.02
Iowa	0.25	0.07	0.12	0.40	0.02
Kansas	0.22	0.09	0.00	0.40	0.02
Kentucky	0.21	0.11	0.00	0.55	0.02
Louisiana	0.22	0.08	0.09	0.36	0.02
Maine	0.26	0.12	0.08	0.35	0.06
Maryland	0.25	0.10	0.00	0.45	0.02
Massachusetts	0.24	0.10	0.00	0.39	0.02
Michigan	0.25	0.08	0.00	0.44	0.02
Minnesota	0.19	0.09	0.00	0.36	0.02
Mississippi	0.17	0.06	0.00	0.28	0.02
Missouri	0.22	0.13	0.00	0.42	0.03
Montana	0.24	0.10	0.12	0.36	0.04
Nebraska	0.21	0.11	0.00	0.50	0.03
Nevada	0.23	0.01	0.23	0.23	0.01
New Hampshire	0.28	0.05	0.23	0.31	0.03
New Jersey	0.33	0.21	0.15	1.00	0.06
New Mexico	0.14	0.11	0.01	0.23	0.06
New York	0.24	0.13	0.00	0.67	0.02

Table 36. NUMERICAL SUMMARY OF STATES -- ATTRITION (CONT D.)

STATE	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
North Carolina	0.27	0.19	0.10	1.00	0.04
North Dakota	0.23	0.18	0.12	0.50	0.09
Ohio	0.22	0.16	0.00	1.00	0.02
Oklahoma	0.24	0.09	0.09	0.50	0.02
Oregon	0.20	0.15	0.00	0.34	0.06
Pennsylvania	0.27	0.10	0.00	0.54	0.01
Rhode Island	0.25	0.02	0.23	0.26	0.02
South Carolina	0.18	0.08	0.00	0.32	0.02
South Dakota *	0.27		0.27	0.27	
Tennessee	0.13	0.09	0.00	0.27	0.02
Texas	0.21	0.08	0.00	0.39	0.01
Utah	0.22	0.12	0.00	0.39	0.04
Vermont	0.27	0.10	0.17	0.37	0.06
Virginia	0.19	0.08	0.00	0.30	0.02
Washington	0.22	0.08	0.00	0.35	0.02
West Virginia	0.21	0.07	0.00	0.30	0.02
Wisconsin	0.19	0.12	0.00	0.60	0.02
Wyoming	0.24	0.03	0.22	0.26	0.02
* Only one unit in sample from South Dakota					

Table 37. NUMERICAL SUMMARY OF STATES -- LOSSES

STATE	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
Alabama	24.27	19.05	0.00	81.00	4.06
Arizona	17.88	14.48	1.00	42.00	5.12
Arkansas	31.45	26.09	0.00	90.00	7.87
California	26.30	27.68	0.00	100.00	3.80
Colorado	37.00	43.03	0.00	108.00	14.34
Connecticut	39.75	37.07	0.00	131.00	10.70
Delaware	17.80	11.69	1.00	28.00	5.23
Florida	26.53	24.07	0.00	77.00	4.13
Georgia	34.70	41.44	0.00	148.00	9.27
Idaho	43.75	42.33	0.00	100.00	21.17
Illinois	23.71	22.41	0.00	69.00	3.50
Indiana	27.62	25.24	0.00	75.00	5.15
Iowa	27.00	25.27	1.00	72.00	7.01
Kansas	11.26	10.05	0.00	41.00	2.09
Kentucky	18.26	27.35	0.00	138.00	4.62
Louisiana	31.13	27.57	3.00	84.00	7.11
Maine	35.75	27.88	6.00	61.00	13.94
Maryland	48.19	53.42	0.00	241.00	10.48
Massachusetts	26.11	25.94	0.00	89.00	5.09
Michigan	28.37	25.82	0.00	94.00	5.06
Minnesota	25.55	23.47	0.00	86.00	5.25
Mississippi	16.75	11.07	0.00	35.00	2.77
Missouri	13.80	11.87	0.00	42.00	2.65
Montana	36.60	30.54	5.00	80.00	13.66
Nebraska	13.38	15.97	0.00	66.00	3.99
Nevada	30.50	17.68	18.00	43.00	12.50
New Hampshire	36.33	14.50	22.00	51.00	8.37
New Jersey	31.38	23.98	1.00	64.00	6.65
New Mexico	19.00	23.64	2.00	46.00	13.65
New York	32.23	35.74	0.00	203.00	4.47

Table 38. NUMERICAL SUMMARY OF STATES -- LOSSES (CONT D.)

STATE	MEAN	STD DEV	MIN VALUE	MAX VALUE	STD ERR OF MEAN
North Carolina	32.65	27.68	1.00	108.00	6.19
North Dakota	15.00	9.863	2.00	26.00	4.93
Ohio	21.66	20.09	0.00	78.00	3.26
Oklahoma	19.84	15.60	1.00	64.00	3.58
Oregon	13.00	15.15	0.00	38.00	6.19
Pennsylvania	36.58	29.66	0.00	119.00	4.00
Rhode Island	33.00	19.80	19.00	47.00	14.00
South Carolina	19.10	17.45	0.00	58.00	3.81
South Dakota *	71.00		71.00	71.00	
Tennessee	18.73	21.67	0.00	60.00	5.60
Texas	21.92	21.92	0.00	92.00	2.98
Utah	28.11	38.57	0.00	126.00	12.86
Vermont	29.33	31.34	1.00	63.00	18.10
Virginia	24.18	23.54	0.00	96.00	5.02
Washington	19.41	21.99	0.00	85.00	4.23
West Virginia	26.75	17.28	0.00	51.00	4.32
Wisconsin	17.48	15.38	0.00	65.00	2.96
Wyoming	19.00	16.97	7.00	31.000	12.00
* Only one unit in sample from South Dakota					

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